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MILITARY SPECIFICATIONS

TACTICAL TERRAIN ANALYSIS DATA BASE (TTADB)
SCALE 1:50,000

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope.

a. This specification establishes the first edition military specification requirements for the Defense Mapping Agency's (DMA) Tactical Terrain Analysis Data Base (TTADB).

b. The DMA Terrain Analysis Program is a dynamic program; consequently, this manual may not identify all necessary specifications encountered in the production of terrain analysis data bases. Supplementary instructions will need to be generated in areas that require modification of these specifications.

1.2 Purpose. Conformance to these specifications will assure uniformity of treatment among all mapping and charting elements engaged in a coordinated production and maintenance program for this product.

1.3 Security.

1.3.1 Security classification. The security classification of the products generated by the use of these specifications will be the lowest category practicable. When it is necessary to assign a security classification to the product, it will be accomplished in accordance with established national security procedures.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, Defense Mapping Agency, ATTN: PR, 8613 Lee Highway, Fairfax, VA. 22031-2137 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

AREA MCGT

1.4 Applicability

a. These specifications apply to all TTADBs produced by the Defense Mapping Agency and those produced for the Defense Mapping Agency as a result of either government contract or unit tasking. They are not applicable to rapid-response products.

b. For rapid-response products, the lineweights, length of dashes and spaces, and other dimensions shown in the specifications column of Appendix B - Symbols may be approximated. Lines may be delineated by fine, medium, or heavy lines and the overlays freehand lettered.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the current Department of Defense Index of Specifications and Standards (DODISS) and the supplement thereto, cited in the solicitation (see 6.10).

SPECIFICATIONS

MILITARY

MIL-T-89301 - 1:50,000 Scale Topographic Maps of Foreign Areas

STANDARDS

MILITARY

MIL-STD-600002 - MC&G Symbology.
MIL-STD-600004 - MC&G Geographic Names
MIL-STD-600010 - DMA Stock Number Bar Coding

NORTH ATLANTIC TREATY ORGANIZATION (NATO) STANDARDIZATION AGREEMENTS (STANAG)

2251 MGD - Scope and Presentation of Military Geographic Information and Documentation (MGID), MAS(ARMY) 2254(78) 471.
2253 MGD - Military Geographic Documentation - Roads and Road Structures, MAS(ARMY) (74) 862.
2254 MGD - Navigable Inland Waterways, MAS(ARMY) 2254(78) 471.
2256 MGD - Inland Hydrography, MAS(ARMY) (71) 86[illegible]
2257 MGD - Railways, MAS(ARMY) 2257(79) 491.

(Copies of unclassified federal, commercial and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

a. "The Unified Soil Classification System", Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vols. 1 and 3, March 1953 (Revised April 1960).

b. Technical Manual TM 5-530, Materials Testing, Departments of the Army, the Navy, and the Air Force, February 1971.

c. Soil Survey Staff, 1975, Soil Taxonomy: A Basic System for Making and Interpreting Soil Surveys, Agricultural Handbook No. 436, USDA, U.S. Government Printing Office, Washington, D.C.

d. Datums, Ellipsoids, Grids, and Grid Reference Systems, DMA TM 8358.1, DMA Stock No. DMATM83581TEXT. Available from the Defense Mapping Agency, ATTN: PR, 8613 Lee Highway, Fairfax, VA. 22031-2137.

2.2 Non-Government publications

This section is not applicable to this specification.

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards) the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Accuracy.

3.1.1 Horizontal and vertical accuracy.

a. The horizontal and vertical accuracy of the TTADB will normally be no better than the base to which it is keyed. There is often variation in the accuracy of 1:50,000 scale topographic maps. Current imagery will be used to update the accuracy of the base map to show significant changes in alignment (features displaced on the base map by more than 2mm or 100 meters ground distance), feature characteristics, new features, and/or relative position of features to each other.

b. In some instances 1:50,000 scale topographic maps are not available and enlarged smaller scale maps or photomosaics will be used as bases. These bases may be significantly less accurate than a 1:50,000 scale topographic map.

3.1.2 Displaced symbols. Feature symbols which are displaced as a result of hard copy output are excluded from the accuracy requirements as stated in paragraph 3.1.1a. above.

3.1.3 Vertical stacking.

a. Thematic overlays shall be prepared so that when combined (stacked) with other thematic overlays of a given data base (the set of TTADB overlays for a particular base map or sheet), the features shall bear the correct positional relationship and compatibility with each other.

b. Features that are common (e.g., Common Open Water, Common Built-up/ Urban Areas) to two or more overlays of a given sheet shall be exactly aligned.

c. All overlays shall contain corner ticks registered to the base map which are 6.35 mm (.25 in) in length on each side with a line weight of 0.30 mm (0.012 in.). Corner ticks of two or more overlays of a given sheet shall exactly align when vertically stacked using the Universal Punch Registration System.

3.2 Datum.

3.2.1 Horizontal datum. Horizontal Datum shall be the same as the base map to which the TTADB thematic overlays are keyed.

3.2.2 Vertical datum. Vertical Datum shall be the same as the base map to which the TTADB thematic overlays are keyed.

3.3 Adjoining data set and chart match.

a. All thematic overlays shall be edge-matched between sheets within a project area and with sheets in other surrounding, current and previous project areas.

b. When new TTADB data sets or sheets are produced using more current sources and adjacent sheets are not updated, exceptions to paragraph a. above can occur. All information shall be matched with adjoining data sets or overlays as best possible. In achieving match, however, no errors of position shall be introduced into new production, nor shall any factual errors be made in an attempt to tie adjoining areas. In these cases, the new TTADB production shall show the later date information.

3.4 Series. The series number for any given TTADB overlay is identified by the use of the series number of the base map to which it is keyed followed by the letters "TTA". These letters are the standard TTADB series identification. The complete series number type size, style, and positioning are as shown in Appendix A, Style Sheets, and as described in 3.11, Margin Data.

3.5 Quality. Final product quality shall reflect the quality elements expressed by each appropriate section within this specification and the cited specifications, standards, and handbooks of 2.1.1.

3.6 Scale. The TTADB shall be produced at 1:50,000 scale.

3.7 Overlay design. The TTADB is a product developed to satisfy the armed services requirements for hard copy overlay terrain analysis data.

3.7.1 Format.

a. TTADB overlays are formatted: (1) as shown on the style sheets, Appendix A; (2) with marginal data as prescribed in paragraph 3.11, Marginal Information; (3) with legends as shown in Appendix D; and (4) with symbology as illustrated in Appendix B.

b. The legends for each thematic overlay (See Appendix D, Legends Appendix) will normally be the same for all sheets in the project and must include all categories found in the project area whether or not they appear on an individual sheet.

3.7.2 Overlay limits and insets. Individual sheet (base map) coverage limits shall be as defined by the Area Requirements and Product Status (ARAPS) file. In turn, the TTADB overlays shall be positioned to the corner geographic coordinates of the base map to which they are keyed. Insets on the base map shall be shown in the same way and in the same position on the TTADB overlays. The additional corner ticks shall be shown as per the base map.

3.7.3 Neatlines. Cartographic detail within the TTADB overlays shall not extend beyond the neatline of the base map to which they are keyed. Features which cross the neatline shall be truncated exactly at the neatline, with the remaining portion of the feature portrayed on the adjoining sheet.

3.7.4 Registration. All TTADB overlays, both initial and final, shall be punch registered using the Universal Punch Registration System.

3.8 Size and dimensions.

3.8.1 Map sheet sizes. Refer to Appendix C, Size limits for 1:50,000 Map Sheet, for overall dimensions of map sheets.

3.8.2 Unit of measure.

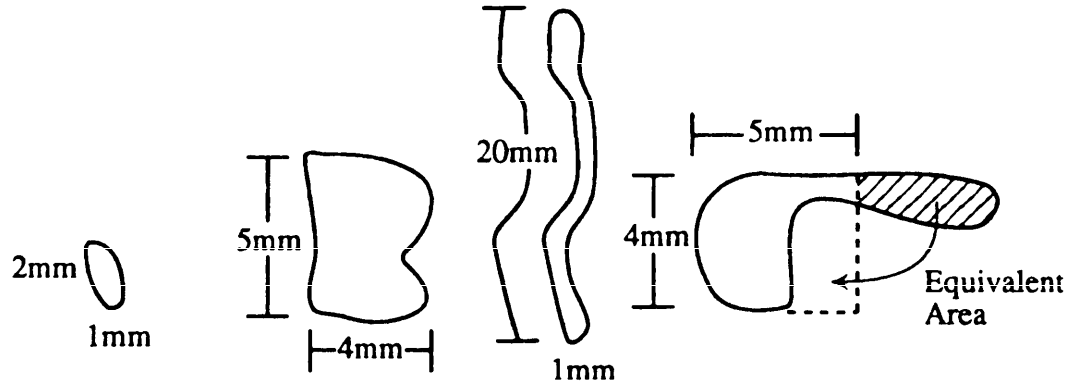
a. The Unit of Measure for the TTADB is Metric; however, both English and Metric Units are provided in Appendices A, B, C and I of this specification.

b. Specification measurements are normally given at reproduction scale, i.e., 1:50,000.

3.8.3 Minimum sizes.

a. The minimum size polygon shown on most of the overlays shall have an areal extent of at least 20 square millimeters at map scale (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance). The smallest polygons shown are on the Surface Drainage Overlay, where open water and islands have an areal extent of at least 2 square millimeters (5000 square meters ground area) with a minimum width of at least 1mm (50m ground distance). For long narrow polygons, straight or curved, the length is the centerline distance measured from one end to the other. (See Figure 1).

b. The minimum lengths shown vary with different thematic overlays, but in general range from no minimum length to 5mm (250m ground distance). Normally, all features less than 2mm (100m ground distance) in length are treated as point features, whereas those equal to or greater than 2mm (100m ground distance) are considered linear features.



a. Minimum Size Polygon for Surface Drainage Overlay

b. Minimum Size Polygons for the other Thematic Overlays

FIGURE 1. Minimum size polygons (not to scale).

3.8.4 Linework.

a. All interior information must fall within the neatlines. All linework that intersects the neatline or other areal features must terminate precisely at the neatline or other areal feature. Gaps and tails at line intersections are not acceptable.

b. Lines used to outline areal features on the Surface Configuration, Vegetation and Surface Materials Overlays shall have a lineweight of 0.30mm (0.012 inches).

c. Most of the linework, symbols, data information holders, etc., on the Surface Drainage, Transportation, and Obstacles Overlays shall also have a lineweight of 0.30mm (0.012 inches). Leader lines are the major exception; all leader lines (no matter on which overlay they appear) shall have a lineweight of 0.20mm (0.008 inches). Refer to paragraph 3.22 for additional information.

3.9 Projection. TTADB overlays shall use the same projection as the base map or sheet to which they are keyed.

3.10 Reference system. The TTADB does not require the application of any grid reference system. The grid as positioned on the base map is used when needed.

3.11 Margin Data.

3.11.1 Positioning. The margin space available will vary in size (width) depending upon the size of the geographic area encompassed by the base map. However, all marginal data contained on each overlay shall be positioned between the work limits and the neatlines.

3.11.2 Style sheets.

a. Appendix A, Style Sheets, provides guidance on the design, composition, and location of all marginal information, as well as on the

positioning, type size, and type style. In addition all items are referenced to their paragraph/subparagraph number in this section.

b. The location of marginal data shown in the style sheets represents the preferred positioning of the marginal items. If exact positioning of long or large items (long names, lengthy translations, additional legend notes, etc.) causes items to touch or overlap, they may be displaced or relocated as necessary to present a pleasing appearance, while keeping with the general setup of the style sheets.

3.11.3 Marginal information for thematic overlays from reproduction material.

a. The following border information will be shown on the final overlays and is obtained from a duplicate negative of the culture plate of the reproduction material of the 1:50,000 scale topographic base map:

(1) Sheet Name
(2) Series Name and Scale
(3) Series Number
(4) Edition Number
(5) Sheet Number
(6) Corner Geographic Coordinates
(7) Publisher's Note (if published by the same agency or military command producing the TTADB)
(8) Adjoining Sheets Diagram
(9) Bar Scale
(10) Neatline

b. All other information on the culture negative is deleted.

3.11.4 Other marginal information for thematic overlays to be added to the reproduction negative. Information to be added to the reproduction negative includes:

3.11.4.1 User's note. The User's Note (as stated below) placed just above the bar code in the lower right corner:

USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS FOR IMPROVING THIS PRODUCT TO: DIRECTOR, DEFENSE MAPPING AGENCY, ATTN: PR, 8613 LEE HIGHWAY, FAIRFAX, VA. 22031-2137

3.11.4.2 Keyed to statement. The words "Keyed to" shall be placed immediately to the left of the word "EDITION" and should have approximately the same size letters as "EDITION".

3.11.4.3 Publisher's note.

a. If the TTADB is produced by a different agency or military command than that which published the topographic base map, its publisher's note shall replace the original note. This note, in 8 point capital and lower case letters (C/L), will be placed in the same location as the original and will have the following format:

inch in length

Prepared and published by ...(agency or military command name and address)

b. As an example, the publisher's note for DMAHTC produced TTADB's is:

Prepared and published by the Defense Mapping Agency, Hydrographic/Topographic Center, Washington, D.C. 20315-0030

3.11.4.4 Compilation note. The following compilation note, as stated below, shall be added below the Publisher's Note and should have approximately the same type size and style as the Publisher's Note:

Compiled in (year) from best available and most current source materials. Feature information and positional accuracy on overlays will take precedence over that on the topographic map.

3.11.4.5 TTADB series identifier. The letters "TTA" shall be added between the Series Number and the Sheet Number as a part of the Series Number and should have approximately the same size letters as the Series Number. This is the standard TTADB series identifier.

3.11.5 Additional marginal information to be added to individual thematic overlays. Additional marginal information will be added to each of the final overlays as follows:

3.11.5.1 Legend(s).

a. Sample legends are shown in Appendix D for all thematic overlays. Legends can be reduced in size to fit available space, as long as information remains legible.

b. The Obstacles Legend should be positioned as far left as possible within the limits shown on the Vertical Style Sheet, Appendix A, page 109, and at the top of the limits shown on the Horizontal Style Sheet, Appendix A, page 110.

3.11.5.2 Classification. Classification (N/A if unclassified), with related notes and guidance, is added to each thematic overlay as required.

a. When a security classification is required, it shall be positioned in the upper left and lower right areas of the overlay margin, centered as much as possible, as indicated on the style sheets in Appendix A.

b. Any Special Handling Note or Down Grading Note, when required, shall be shown in accordance with current established policy and wording, and positioned in the lower right margin below the security classification.

3.11.5.3 Overlay headings (top and bottom of overlay). Overlay headings will appear on final overlays as all caps or a combination of caps and lower case as illustrated below. The heading at the top of the overlay will be a single line as indicated below. The heading at the bottom of the overlay will either be one or two lines. The second line, if needed, will consist of any heading information in parentheses. Overlay headings are as follows:

SURFACE CONFIGURATION (Slope)
VEGETATION
SURFACE MATERIALS
SURFACE DRAINAGE
TRANSPORTATION
TRANSPORTATION (Roads)
TRANSPORTATION (Railroads and Airfields)
BRIDGE INFORMATION TABLE
OBSTACLES

3.11.5.4 DMA bar code block.

3.11.5.4.1 Positioning and use of bar code block. The DMA bar code block is located horizontally on the south work limit, below the user's note, right justified. The bar code block is shown as two lines. The top line is the bar code itself. This is a machine readable encoding of the overlay's stock and edition numbers, which are printed in human readable interpretation (HRI) just below it. The bar code serves as an automated identification and inventory control tool for the DMA Combat Support Center. It conforms to the requirements of the DMA Automated Distribution Management System (DADMS) and MIL-STD-600010.

3.11.5.4.2 Minimum dimensions. As per MIL-STD-600010, the minimum sizes for the contents of the bar code block are:

a. Bar code height - 6.35mm (.25in)
b. Space between bar code and HRI - 0.25mm (.01in)
c. Text "DMA STOCK NO." - 1.8mm (.07in)
d. HRI stock number height - 3.175mm (.125in)
e. Text "ED. NO." - 1.8mm (.07in)
f. HRI edition number height - 3.175mm (.125in)
g. Minimum margin below HRI - 1.524mm (.06in)
h. Quiet zone before and after bar code - 6.35mm (.25in)
i. Space between parts of bar code - 12.7mm (.5in)

3.11.5.4.3 Bar code content. The bar code begins with a start code followed by the stock number, stop code, minimum 12.7mm (0.5in) space, start code, edition number of three digits, ending with a stop code. See Figure 2 for an example bar code block.

Figure 2. Example DMA bar code block for a TTADB vegetation overlay.

3.11.5.4.4 DMA stock number. The DMA Stock Number is limited to 15 characters and is composed of four parts:

a. Series Number of the topographic map to which the overlay is keyed. Five-character Series Numbers do not show the fifth character (e.g., L7016 becomes L701).

b. Letter D denoting non-lithographic product series.

c. Sheet Number of topographic map to which overlay is keyed.

d. Identification code for the specific terrain factor overlay:

T01	Surface Configuration (Slope)
T04	Surface Materials
T07	Surface Drainage
T10	Obstacles
T13	Transportation
T16	Transportation (Bridge Information Table)
T19	Transportation (Roads)
T22	Transportation (Railroads and Airfields)
T25	Vegetation

3.11.5.4.5 Further information on bar code block. For more information about the DMA bar code block refer to MIL-STD-600010.

3.11.6 Marginal information for Bridge Information Table. The following represents the marginal information portrayed on a Bridge Information Table. Refer to appendix A, pages 111 to 113, for the Bridge Information Table format.

3.11.6.1 Title. (As stated below) - 24 pt. capital letters (Caps):

BRIDGE INFORMATION TABLE

3.11.6.2 Series name and scale. - As on base map.

3.11.6.3 Classification. (As needed) - 24 pt. Caps. Other classification markings and or notes (As needed) - 12 pt. Caps.

3.11.6.4 Sheet name. - As on base map.

3.11.6.5 Sheet number. - As on base map.

3.11.6.6 Publisher's note. (As stated below or as per 3.11.4.3)- 8 pt. capital and lower case letters (C/l) or as on base map:

Prepared and published by the Defense Mapping Agency,
Hydrographic/Topographic Center, Washington, D.C. 20315-0030

3.11.6.7 Compilation note. (As stated below)- 8pt. C/l or as on base map:

Compiled in (year) from best available and most current source materials. Feature information and positional accuracy on the overlays will take precedence over that on the topographic base.

3.11.6.8 Abbreviations and acronyms. (If necessary, these may be divided into two or more columns across the bottom margin of the Bridge Information Table) - 10 pt. C/l:

NOTES: TWW = Traveled Way Width
OHC = Overhead Clearance

UBC = Underbridge Clearance
BBP = Bridge Bypass Potential
U = Unlimited Clearance
R = Restricted Clearance

CODES: BBP Codes: E = Easy, D = Difficult, I = Impossible
Construction Material Codes: C = Concrete, W= Wood,
S = Stone, ST = Steel, SB = Stone or Brick,
RC = Reinforced Concrete, PC = Prestressed Concrete

3.11.6.9 User's note. (As stated below) - 6 pt. Caps:

USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS FOR IMPROVING THIS PRODUCT TO: DIRECTOR, DEFENSE MAPPING AGENCY, ATTN: PR, 8613 LEE HIGHWAY, FAIRFAX, VA. 22031-2137

3.11.6.10 DMA bar code block. As per paragraph 3.11.5.4 above.

3.11.6.11 Word "Accompanies". The word "Accompanies" is inserted in front of Series Number - 10 pt C/1.

3.11.6.12 Series number. - As on base map.

3.11.6.13 TTADB series identifier. Standard TTADB series identifier letters "TTA" following Series Number - Approximately same size as the Series Number on base map.

3.11.6.14 Type size within body of Bridge Information Table. All information and data within the Bridge Information Table is 8 pt. C/1.

3.11.7 Multilingual marginal information. Some NATO and other countries have international map standardization agreements or bilateral cooperative mapping arrangements with DMA and the U.S. which dictate the use of multilingual marginal information on materials produced over their countries. When this is the case for TTADB's, the language or languages to be shown, in addition to English, shall be identified in supplementary instructions for the project. As a minimum, the items listed below shall be translated:

a. Marginal information headings (bar scale, adjoining sheets, etc.), notes (publisher's, compilation, etc.), and all sheet identifiers, except sheet name and bar code.

b. All legend items on the individual overlays of the TTADB set.

c. When required, the security classification notes.

3.12 Culture. This section provides specification guidance for the production of the TTADB Transportation Overlay.

3.12.1 General transportation information.

a. The symbols and attributes on this thematic overlay represent selected transportation features over which troops and supplies can be moved during a tactical military operation.

b. Transportation legend categories are shown in Appendix D, pages 140 through 143. Symbology for depiction of transportation features are shown in Appendix B, pages 117 through 124.

c. All attribute or measured data for transportation features derived from imagery will be rounded to the nearest half meter (0.5m). If confirming collateral data is available showing a greater degree of precision, this real data will be used in their proper positions in the various transportation symbols, data information holders, and tables requiring the attributes.

d. If associated properties for an object can not be determined from the various source materials, then their related attributes called for in the various transportation feature symbols, data information holders and tables are left blank. These data omissions will be updated later as data becomes available.

3.12.2 Number of transportation thematic overlays. The transportation thematic subject can be portrayed as one to three overlays:

a. The most common portrayal is to symbolize the roads, railroads, and airfields on one overlay and to have the Bridge Information Table as a second, separate overlay.

b. If the transportation features are extremely dense or the thematic overlay becomes cluttered with excessive coding (for example: along a high density corridor), the roads can be portrayed on one overlay, the railroads and airfields on another overlay, and the Bridge Information Table on a third overlay.

c. If space permits, all the information can be combined onto a single overlay. This is rare, except for coastal sheets that have only a few bridges and large expanses of common open water. In these cases a short Bridge Information Table, tailored to the number of bridges on the overlay and wholly contained within the neatlines, may be placed in the common open water area. If room is available, and there are five or less bridges, the bridge information table may even be placed in the margin of the overlay along with the other marginalia.

3.12.3 Transportation leader lines.

3.12.3.1. Transportation leader line use. Leader lines are used to link offset feature symbols, data, and data information holders with their actual feature locations and symbols. They are always used with data information holders and the sharp curve, passing track, siding, yard, side drop and overhead drop symbols, as well as any symbols which must be offset from their normal position for map legibility. Leader lines may also be used with the steep gradient, ford and ferry symbols, as well as the feature under construction symbol. Note that leader lines will maintain a gap of 0.25mm (0.01 in) between their end points or arrowheads and the lines and symbols to which they are pointing. Whereas leader lines touch referenced data information holders and offset pictorial symbols, a gap of 1.0mm (0.04in) gap will be maintained between leader lines and referenced alphanumeric characters (symbols in some cases). A gap of 0.5mm (0.02in) shall be maintained between symbolized linework, leader lines, and data information holder lines and any data placed above or below these lines. Figure 3 illustrates the use of leader lines.

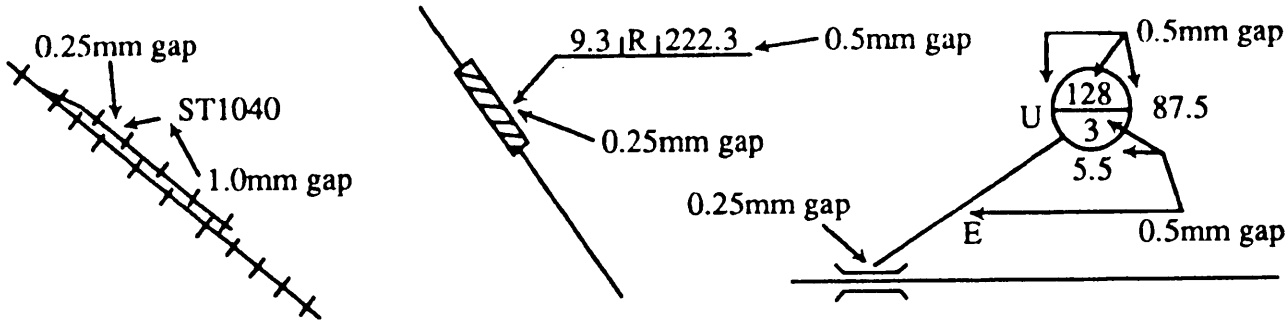


FIGURE 3. Use of leader lines and gaps between symbols and alpha/numerics.

3.12.3.2 Leader lines without arrowheads. Leader lines without arrowheads indicate point features or minimum size symbols (symbolized features with a longitudinal ground axis of less than 2mm [100m ground distance]).

3.12.3.3 Leader lines with arrowheads.

a. Leader lines with arrowheads are used to indicate areal and lineal features (symbolized features with a longitudinal ground axis of greater than or equal to 2mm [100m ground distance]), "to scale" symbols, and data displaced from its normal position, such as offset road widths. They are also used when word symbols indicating the extent or condition of a specified feature must be offset.

b. Arrowheads will terminate 0.25mm (0.01 in) from their target line, symbol, or area, pointing towards the mid-point of the longitudinal axis of a depicted linear feature or center of an areal feature.

3.12.4 Approximate alignment. Sections of linear transportation features which can not be accurately positioned on the overlay are labeled "approximate alignment". Lettering should be read left to right and be above the line segment. This condition usually occurs through heavily wooded or desert areas, or when field reconnaissance discovers new features not shown in the collateral source materials or on the imagery.

3.12.5 Road classification. The classification for the road network consists of five categories which generally correspond to those on a 1:50,000 scale topographic map. The number of roads shown is dependent upon whether the area is inside or outside of urban areas.

3.12.5.1 Roads inside urban areas. Inside the urban areas only major through routes which serve as traffic corridors to other places shall be shown. If possible, the depiction of major through routes should avoid existing or potential bottlenecks and hazards such as residential streets, side roads, dead ends, narrow or twisting streets, steep gradients, sharp curves, narrow (< 5m wide) and/or weak (< 60 MLC - non main battle tank supportable) bridges, and roads passing under or through overhead obstructions. (Note that in Figure 4 the urban area is shown for illustrative purposes only. Urban areas are not shown on the Transportation thematic overlay(s)).

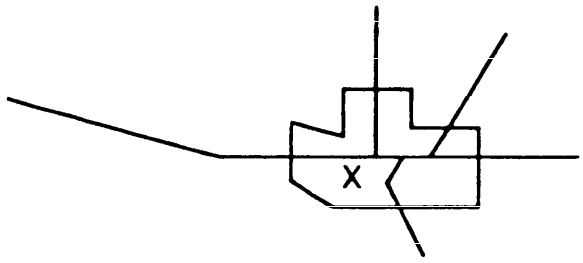


FIGURE 4. Roads in urban areas.

3.12.5.2 Roads outside urban areas.

3.12.5.2.1 Selection of representative road pattern. The number of roads shown outside the urban areas depends on the number, density and type of roads found in a specific geographic area. If the road network is numerous and/or dense, emphasis is placed on depicting only major (all weather) roads. Conversely, if the road network is sparse, emphasis is also placed on depicting minor or lower level road categories such as fair weather roads and tracks. The road network depiction must cover the entire overlay with a representative pattern of the various road classes shown from the all weather roads to at least a sampling of the connecting minor roads. The final road network links together all major transportation routes, transfer points (airfields, ports, railheads, etc.), urban areas, and military facilities.

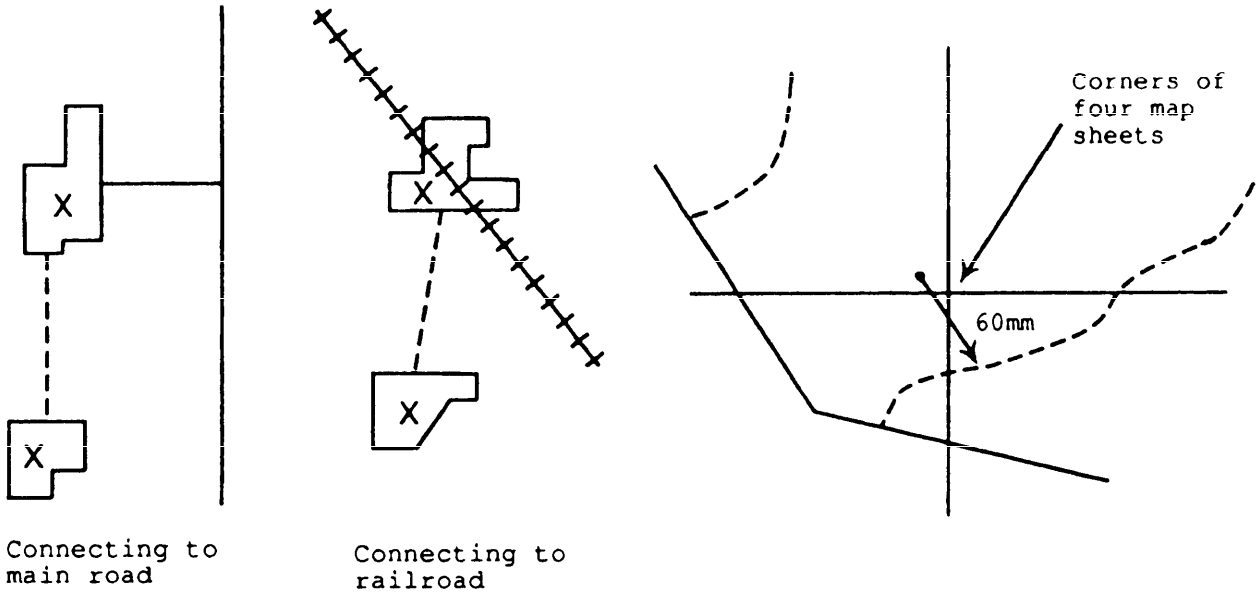
3.12.5.2.2 Rules for selection of representative road pattern. Roads are normally shown in a hierarchical order of categories from all weather, hard surface, dual lane highways to tracks (see order and definitions in 3.12.5.3 below).

a. All built-up areas, as portrayed on the Vegetation Overlay, should be connected to the main transportation network by at least one road (in order of hierarchical preference) leading to another urban area, transportation feature, or military base. (See Figure 5a.)

b. No point should be more than 60mm (3000m ground distance) from a depicted road, if indeed a road does exist that close to the point. Along edges and in corners adjacent product or map sheet areas are checked to determine if a road is within 60mm. (See Figure 5b.)

c. Minor roads running parallel to, or nearly parallel to, or closely approximating major routes at a distance of less than 10mm will not be shown, unless such parallel road sections are necessary to show connections to other roads. (See Figure 5c.)

d. Outside of the built-up areas, average road density should be at least one road per 3600 square millimeters. However, where necessary, intersecting and connecting minor roads may be shown between higher category roads. (See Figure 5d.)



a. Built-up Areas Connected to the Transportation Net.

b. All Points within 60mm of a Road.

c. Treatment of Paralleling Minor Roads.

d. Minor Roads Connecting Major Roads.

FIGURE 5. Minor road representative pattern rules.

3.12.5.3 Road network categories and classification descriptions.

a. **All Weather, Hard Surface, Dual or Divided Highway/Road** (Symbol 600) - A waterproof surface having adequate drainage and only slightly affected by precipitation or temperature fluctuations (i.e., rain, snow, cold, thaw, and heat). These roads are designed to carry heavy traffic and are passable throughout the year to a volume of traffic never appreciably less than its maximum dry weather capacity. Rarely is this road type closed by weather effects other than snow blockage or floods. The two sides of the dual/divided roads are usually divided from each other by a grass median strip or by a concrete or steel barrier. Road surface/construction materials: concrete, bituminous (asphaltic) concrete

(bituminous plant mix), paving brick or stone, or bituminous surface on paving brick or stone.

b. **All Weather, Hard Surface Highway/Road** (Symbol 601) - A waterproof surface having adequate drainage and only slightly affected by precipitation or temperature fluctuations. These roads are designed to carry heavy traffic. With reasonable maintenance they are passable throughout the year to a volume of traffic never appreciably less than its maximum dry weather capacity. Rarely is this road type closed by weather effects other than snow blockage or floods. Road surface/ construction materials: concrete, bituminous (asphaltic) concrete (bituminous plant mix), paving brick or stone, bituminous surface on paving brick or stone, bitumen penetrated macadam, or waterbound macadam with superficial asphalt or tar cover.

c. **All Weather, Loose Surface Road** (symbol 602) - The road surface is not waterproof but graded and drained; it is considerably affected by precipitation and temperature fluctuations. These roads are designed to carry light traffic in all weather, and are kept open in bad weather to a volume of traffic considerably less than its maximum dry-weather capacity. Traffic may be halted for short periods of time. Heavy traffic use during adverse weather conditions may cause complete collapse. Road surface/construction materials: waterbound macadam, crushed rock or coral, gravel or broken stone and cinders, or oil treated gravel.

d. **Fair Weather, Loose Surface Road** (Symbol 603) - The road surface is not waterproof but it is usually graded. These roads are designed to carry light traffic in dry weather only. They quickly become impassable in adverse weather conditions and cannot be kept open to normal traffic by maintenance short of major construction. Traffic may be brought to a halt for long periods of time. Includes logging, corduroy and firelane roads. Road surface/construction materials: natural or stabilized soil, sand, clay, shell, cinders, disintegrated granite, rock, or other select material.

e. **Track** (Symbol 604) - A roadbed that is created by wheeled vehicle use (mostly carts) over a natural traveled way. Generally no road grading or construction designs are used in its development. Rarely is this road type maintained. Winter roads and caravan routes are included within this classification.

3.12.6 Depiction of roads.

3.12.6.1 Road segmentation.

a. On the Transportation Overlay(s) a road segment is defined as an individual section of any road symbol which carries the same classification and attribute characteristics throughout its length.

b. Individual road segments are formed at road junctions (intersections), points of symbology change, and road width change symbols (Symbol 606) indicating road characteristic changes. The correct positioning of road width change markers is illustrated in Figure 6.

c. Railroads crossing roads do not create additional road segments; individual road segments are not formed.

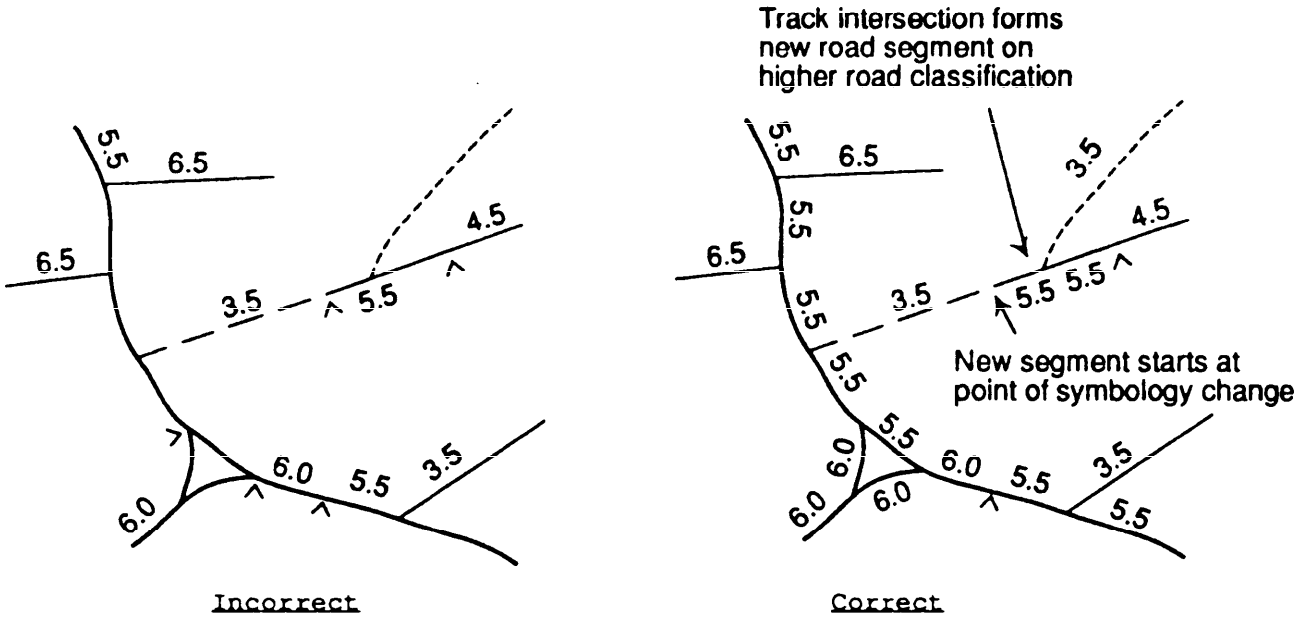


FIGURE 6. Correct positioning of road width change symbols.

d. Point features associated with road segments, such as sharp curves, drop gates, etc., do not affect road segments; individual road segments are not formed.

e. Bridges, tunnels, and other features that roads pass over or through do not affect road segments as long as the road has the same classification and attributes on both sides. If they are different at each end of the feature, the higher road classification, consistent with the design and structural characteristics of the feature, is considered to cross over or through the feature and then change on the other side.

f. A road intersection is defined as an at grade crossing, meeting, or junction of two or more roads. Roads overpassing or underpassing other roads on bridges (or elevated structures) or through tunnels do not affect road segments. Additional road segments are not formed, unless the classification and/or attributes are different on each side of the feature.

3.12.6.2. Short Road Segments.

a. Short road segments are those less than 10.0mm (500m ground distance) in length and comprising less than 50 percent of the length between road intersections or terminus points, that differ in classification or width from the rest of the road. While they are not depicted separately, they can have important implications for military operations and planning.

b. Short road segments, as defined in paragraph a. above, narrower than 4 meters on the ground, shall be annotated with an associated constriction symbol (Symbol 607) as described in 3.12.6.4.

c. Where a stretch of road or road section 10mm (500m ground distance) or less long contains two or more short segments, the lowest classification and

width of the various segments is applied to the entire stretch. New segments will be formed as necessary.

3.12.6.3 **Roadway Width** (Decimal Numeric Value).

a. The roadway width is the total width of road surface available for vehicular travel, commonly referred to as the minimum width of the traveled way. This measurement does not include shoulder or road median measurements. Each road segment is assigned a corresponding roadway width measurement in meters. The roadway width measurement will always be given as a decimal number.

b. The preferred positioning of the numeric value is parallel to, above, and near the center of the road segment, reading left to right. Substantially long road segments will be labeled with more than one roadway width measurement. For each 150mm or part there of, one width measurement shall be given. On long road segments, width measurements shall be evenly spaced between intersections. However, the numeric values on long road segments may be moved up to 30mm from their calculated positions to more horizontal locations. Arrowheaded leader lines are used if the road width values must be offset. If the value is offset it should be placed as close to the road as possible and parallel to the southern neatline.

c. **Roadway width change** symbols (Symbol 606) are used to indicate the point where a roadway width changes without either a classification (symbology) change or an intersection to break the segments. Preferred positioning is below the road, but in congested areas, the road width change symbol may be inverted and shown above the road.

3.12.6.4 **Road constriction** (Symbol 607).

a. Any point along a road segment where the road width narrows to less than 4 meters ground distance is considered to be a road constriction. This may occur at any point along a road segment.

(1) If the constriction is less than 2mm (100m ground distance) in length, it is depicted with the triangles of the associated road constriction symbol (Symbol 607) opposing each other.

(2) If the constriction is between 2mm (100m ground distance) and less than 10mm (500m ground distance), it is depicted with the triangles of the constriction symbol (Symbol 607) offset to the beginning and end of the section from each other.

b. The preferred placement of the road constriction width measurement is adjacent to the lower right side of lowest triangle and parallel to the tangent of the southern neatline.

c. Constrictions are not shown on tracks.

3.12.6.5 **Road gradient** (Symbol 609).

a. Road gradient, or percent (%) slope, is depicted on the overlay when it exceeds 7 percent along any given travelled way, except tracks. The percent slope is the ratio of change in elevation (vertical distance) to horizontal ground distance multiplied by 100. The gradient measurement is determined from the contour

lines on the topographic base map. Road gradient must take into consideration changes from the topographic ground level caused by cuts and fills.

b. The double arrowhead portion of the gradient symbol shall always be parallel to the road and point in the uphill direction.

c. Road gradients can be symbolized in one of three ways depending on their length, as shown in Appendix B, page 118, Symbol 609.

(1) If less than 2mm (100 meter ground distance) long, it will be considered a point feature with a single leaderline extending from between the two triangles to the feature's location on the Transportation Overlay.

(2) If between 2mm (100 meter ground distance) and 4.3mm (215 meter ground distance) long, it will be considered a linear feature with a leader line from each end of the symbol pointing to its corresponding position on the road.

(3) If the length of the steep gradient is longer than 4.3mm (215 meters ground distance), a tail (line portion of the symbol) shall be used to approximate the length and alignment of that portion of the steep grade not covered by the arrowheads.

3.12.6.6 **Sharp curves** (Symbol 610).

a. Sharp curves with a road radius of curvature of 30 meters or less are shown. Intersections are not considered as sharp curves.

b. Preferred positioning of the sharp curve symbol is on the convex side of the curve, parallel to the southern neatline, with a leader line extending from one corner of the symbol to the location of the sharp curve along the road segment, as illustrated in Figure 7a.

c. Sharp curves do not define new road segments.

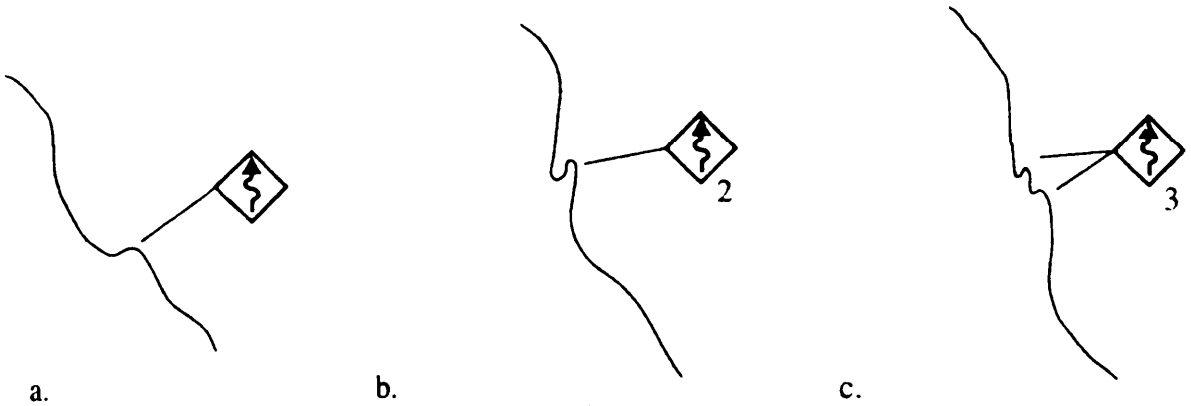
d. Where multiple sharp curves exist within 5mm (250m ground distance) of each other, the following aggregation symbology shall be used:

(1) If two or more consecutive sharp curves occur along a road section within 2mm (100m ground distance) of each other and there are no other sharp curves within 5mm (250m ground distance) of these, a numeric value, indicating the number of sharp curves is placed on the right side of the lower corner of the symbol. A single leader line is used. (See Figure 7b.)

(2) If a series of two or more consecutive sharp curves occur along a road section with none of them more than 5mm (250m ground distance) apart, a double set of leader lines from one corner of the diamond symbol will be used to indicate the section with the aggregated curves. (See Figure 7c.) A numeric value indicating the number of curves is used the same way as in the paragraph above.

e. If multiple sharp curves are more than 5mm (250m ground distance) apart, separate individual and/or aggregate symbols must be used.

with identical characteristics, apart from their representation



a. Single Sharp Curve

b. Multiple Sharp Curves within 100m of each other.

c. Multiple Sharp Curves within 250m of each other.

FIGURE 7. Depiction of sharp curves.

3.12.6.7 **On-route ford** (Symbol 611).

a. A ford is a shallow location in a water body (e.g., stream or open water area) where the physical characteristics of the current, bottom, and approaches permit the crossing of personnel and/or vehicles.

b. All fords along roads portrayed on the Transportation Overlay shall be shown. Fords along minor routes not selected as part of the representative pattern will be shown on the Surface Drainage Overlay as off-route fords (see 3.13.5.1.2).

c. Fords crossing intermittent or ephemeral streams shall be shown. These streams normally flow only briefly, but sometimes violently as upstream precipitation causes a torrent of rapidly rising and subsiding water to race down the stream channel. On projects where this occurs the following warning note will be added to the legend, "Roads through intermittent or ephemeral streams are subject to flash flooding".

d. Roads running along the beds of intermittent or ephemeral streams shall be shown as usual.

e. The symbol for fords is the word "ford" placed either adjacent to the fording site and parallel to the southern neatline or, if longer than 6mm (300m ground distance), parallel to a dashed line indicating the route of the ford through the water body. Where two or more on-route fords occur close together with none of them more than 5mm (250 meters) apart, a numeric value and double set of leader lines indicating their number and location may be used (similar to sharp curves).

3.12.7 Classification and depiction of railroads.

3.12.7.1 Track structure and classification. Railroad tracks are classified and symbolized as to track gauge, number of tracks, and electrification status. Using these criteria, 12 operational track types can be classified and symbolized, as shown in Appendix B, pages 119 through 121, and summarized in Appendix D, page 141.

3.12.7.1.1 Track gauge.

a. Track gauge is the perpendicular distance between the inside of the rails from one inner railhead face to the other measured at a point 5/8 inch below the top of the rail. Track gauges are categorized and depicted on the Transportation Overlay as either narrow, normal, or broad. Normal track gauge is defined as the gauge utilized by the majority of main line railroad tracks found in a particular country. Any gauge which is greater than the normal gauge is defined as broad gauge. Broad gauge is depicted on the overlay by placing the term "broad" parallel to the railroad track alignment (Symbol 617). Narrow gauge track (Symbol 616) is defined as any track smaller than the normal track.

b. Track gauge is country specific. For example, standard gauge, which is defined as 4 feet 8 1/2 inches between the rails, is the normal gauge in the United States, while in the USSR the normal gauge is 5 feet between the rails. Thus, in the USSR standard gauge railroads would be classified as narrow and in the United States the 5 foot would be classified as broad. Therefore, only within country comparisons and classifications of track gauge are made.

c. If known, the actual sizes of the normal, broad, and narrow gauges will be stated in a legend note.

3.12.7.1.2 Number of Tracks. A distinction is shown between single track railroads and multiple track railroads. A single track railroad has one set of tracks on the railway bed; whereas a multiple track railroad has two or more sets of parallel tracks on the same railway bed. Railroad yards, sidings, spurs, and passing tracks are not considered in determining the number of tracks. Any gauge railroad may be multiple tracked.

3.12.7.1.3 **Electrification** (symbol 618).

a. An electrified railroad receives electrical power for engine locomotion relayed through either an electrified wire suspended on overhead poles and pantographs or an electrified third rail along side the track.

b. Any gauge railroad may be electrified.

c. Electrified railroads are symbolized using two dots placed over every other cross tick or set of cross ticks in each track symbol (Symbol 618).

3.12.7.2 Track usage categories, classification and depiction.

3.12.7.2.1 **Main Line Tracks** (Symbols 614 - 617, with or without electrification). Main line tracks form the major linkage of the railway network between built-up areas, transportation transfer points, and military facilities. To be considered as a main line, the track or set of multiple tracks must extend for a distance of at least 20mm (1000m ground distance).

3.12.7.2.2 **Passing tracks** (Symbol 621).

a. A passing track is a section of track that diverges from and runs parallel to the main track with switching connections at both ends. Passing tracks allow for the meeting and passage of trains along a single (usually) main track.

Passing tracks generally have no buildings or loading/storage facilities associated with them.

b. The length of a passing track is designed to handle the temporary pullover of full length trains. Therefore, a passing track is not shown unless its length is greater than or equal to 5.3mm (280m ground distance). The ground length in meters immediately follows the offset "PT" letters.

3.12.7.2.3 **Siding** (Symbol 622) and spur tracks.

a. Siding tracks are auxiliary tracks adjacent to the main track or spur and connected on one (dead-end siding) or both ends (double-ended siding). A siding is used for and generally has facilities for loading, unloading, or storage. Double-ended sidings without other facilities are treated and depicted on the Transportation Overlay as passing tracks, if they closely parallel the main track and their length is greater than or equal to 5.3mm (280m ground distance). Sidings are not shown unless their length is greater than or equal to 5.3mm (280m ground distance). The ground length in meters immediately follows the offset "ST" letters.

b. Spur tracks are tracks which diverge from the main or branch line, over which no regular train service is maintained. Loading, unloading, maintenance, storage and classification are not usually performed on a spur. They usually serve a siding or series of sidings some distance from the main track. Spur tracks between 5.3mm and 20mm (280m - 1000m ground distance) are depicted and treated as siding tracks on the Transportation Overlay. Spur tracks greater than 20mm (1000m ground distance) are treated as main line tracks.

3.12.7.2.4 **Railroad yards** (Symbol 623).

a. Railroad yards are a system of tracks within defined limits; they usually serve as the convergence point of two or more rail lines, but can occur along a single line. Associated features may include many rail lines, storage and handling facilities, passenger terminals, control towers, and/or roundhouses and marshalling and maintenance activities.

b. All railroad yards with a minimum separation of 2mm (100m ground distance) or more between consecutive yards are shown as separate features. On the Transportation Overlay, the outer tracks defining the boundary of the yard, any main tracks passing through the yard, and a representative pattern of interior tracks (maintaining a separation of 1mm between them) will be depicted.

c. The cumulative track length within the rail yard is measured. Only railroad yards with cumulative track lengths equal to or greater than 5.3mm (280m ground distance) are shown. If the main line runs adjacent or juxtaposed to or through the yard feature, it is not included as part of the overall yard length measurement. The ground length in meters immediately follows the offset letter "Y".

3.12.7.2.5 **Dismantled railroad** (Symbol 620). A dismantled railroad is a track system which is no longer in use as a consequence of the tracks and/or bridges being removed. This is the only railroad condition, apart from operational, which has its own symbol and thus does not need to be labelled.

3.12.7.2.6 Railroad under construction. A railroad under construction is one for which construction on the tracks and related features is actually underway. The under construction symbol (Symbol 613) is used the same way for all transportation features including railroads. (See 3.12.14.)

3.12.7.2.7 **Point of change** (Symbol 102). Point of change symbols are used to indicate points where track gauge, condition, or construction status changes without a corresponding change in track line symbology.

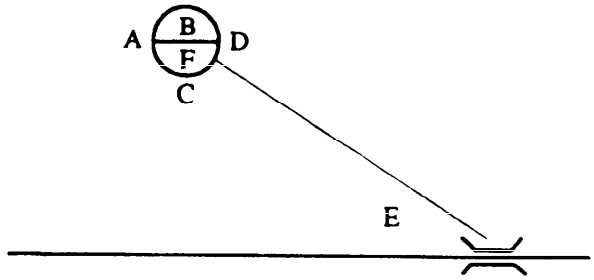
3.12.8 Depiction of **bridges** (Symbols 626, 627, and 628).

3.12.8.1 General bridge definition. A bridge is a structure that carries a railroad or road over a depression, obstacle, drainage, or another transportation feature. A bridge that is completely supported by its two abutments (end supports) is called a single-span bridge. A bridge that has one or more intermediate supports between the abutments is a multispan bridge.

3.12.8.2 Treatment of bridges on the transportation overlay(s). All bridges located along the portrayed railroads and selected road network that can be identified and measured on the imagery or derived from current collateral sources are included on the Transportation Overlay(s). Bridges less than 2mm (100m ground distance) in length shall be treated as point features and depicted with a minimum size bridge symbol (Symbol 626); whereas bridges greater than or equal to 2mm (100m ground distance) shall be treated as linear features and plotted to scale using a minimum size width, if necessary, and a true to scale length. Wider bridges will be plotted to scale in both length and width.

3.12.8.3 Bridge information holders. While all bridges use the same bridge symbol, the feature attributes shown in their data information holders are different. All associated attributes measured from the imagery shall be shown in the bridge information holders to the nearest half meter (0.5m). More precise measurements from field check (on-the-ground) measurements or collateral sources shall be shown both in the bridge information holders and in the Bridge Information Table, as described in 3.12.9. The characteristics covered in the bridge information holders are depicted in accordance with the legend, Appendix D, page 142, and are symbolized as shown in Appendix B, page 122, (Symbols 627 and 628).

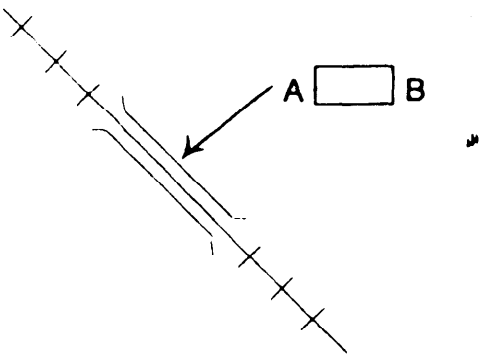
3.12.8.3.1 **Road bridge information holder** (Symbol 627). The symbol indicating the attribute placement for Overhead Clearance, Military Load Classification, Roadway Width, Overall Bridge Length, Bridge Bypass Potential, and Bridge Number is illustrated in Figure 8.



A. Overhead Clearance
B. Military Load Classification
C. Roadway Width
D. Overall Bridge Length
E. Bridge Bypass Potential
F. Bridge Number

FIGURE 8. Attribute placement in road bridge information holder.

3.12.8.3.2 **Railroad Bridge Information Holder** (Symbol 628). As illustrated in Figure 9, the symbol displays the following two railroad bridge attributes: Overhead Clearance and Overall Bridge Length.



A. Overhead Clearance
B. Overall Bridge Length

FIGURE 9. Attribute placement in railroad bridge information holder.

3.12.8.4 Bridge information holder attributes. The Bridge Information Holders will include the following bridge attributes and characteristics. Those associated with each of the two bridge types (road or railroad) are specified in brackets.

3.12.8.4.1 Overhead clearance (Used by both bridge types).

a. Certain bridge types (through truss, suspension, cantilever, through arch and others) usually have some manner of overhead support which may cause an obstruction to certain military equipment and vehicles. Overhead clearance is defined as the least distance (shown in meters) between the transport surface and any obstruction vertically above it. If there is no overhead obstruction, the letter (U) for unlimited clearance is used.

b. The transport surface is defined as:

(1) The traveled way surface for road bridges.

(2) The trackbed or track trestle supports for railroad bridges.

c. In the Transportation Legend (Appendix D, page 142) the overhead clearance corresponds to the letter "A" under both types of bridge data.

3.12.8.4.2 Military load classification (Used by road bridges only).

a. The military load classification (MLC) represents the carrying capacity of a bridge measured in short tons. The value for the lowest MLC for one way traffic either tracked or wheeled corresponds to the letter "B" under Road Bridge Information Holder in the Transportation Legend, Appendix D, page 142.

b. Military load classification values are calculated in part from the stringers under the bridges; therefore, they will be taken from field calculated or collateral source information only. When MLC data is not available, the data entry space shall be left blank.

3.12.8.4.3 Traveled way width (Used by road bridges only).

a. For road bridges this is referred to as the roadway width.

b. Roadway Width.

(1) The width of a bridge roadway surface is measured horizontally from the inner side of one curb, parapet, or guardrail to the other. This clear distance measurement is made perpendicular to the bridge length centerline. See Figure 10. The value corresponds to "C" in the Transportation Legend (Road Bridge Information Holder), Appendix D, page 142.

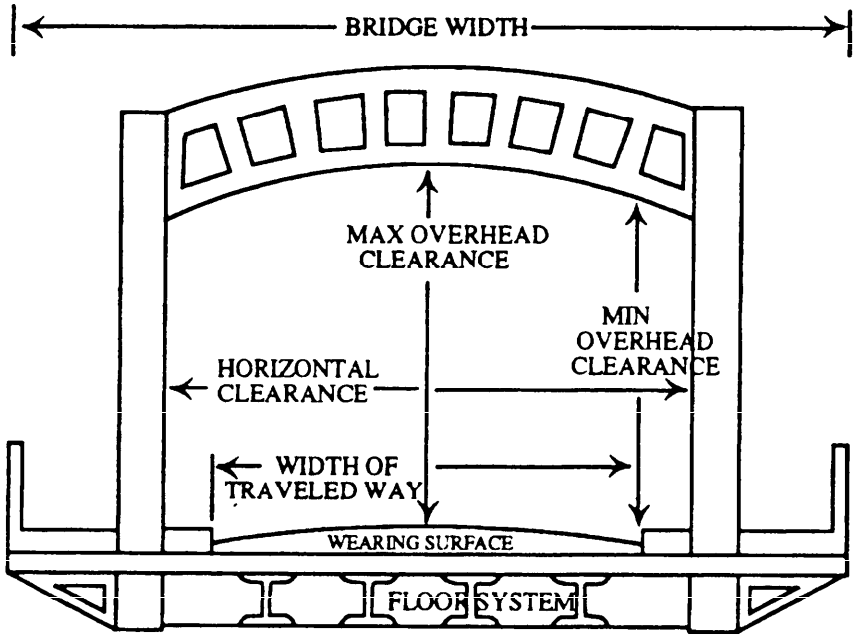


FIGURE 10. Bridge cross section nomenclature.

(2) When the roadway of a bridge has a road divider or barrier, usually of concrete or metal construction, the traveled way width measurement of the bridge shall not include the width of the barrier. See Figure 11.

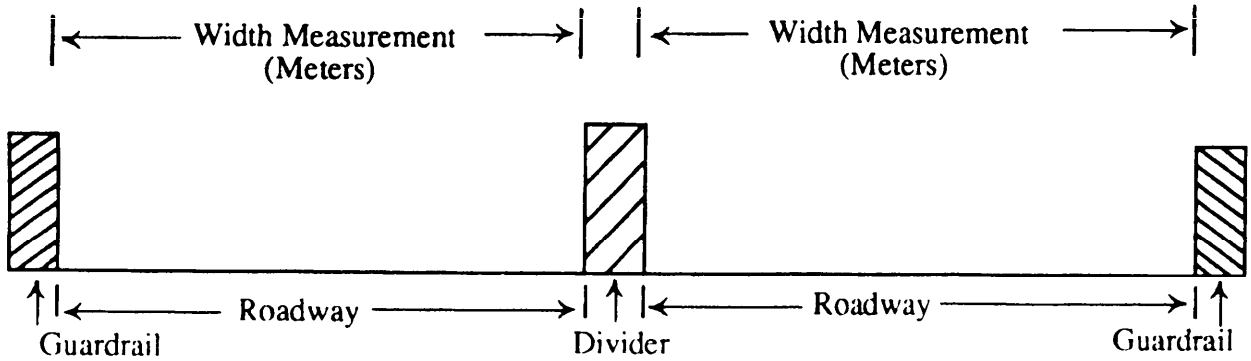


FIGURE 11. Bridge width measurement.

attribute XADDRESS yields the address of the local copy. If parameter passing is by reference

(3) If the roadways on a road bridge are separated with a road divider or barrier, they will be coded in the road bridge information holder as illustrated in Figure 12. For unequally divided roadways on bridges, record the width of the northern most (or west, if vertical) lane(s) first, with a coma separating it from the width of the other lane(s).

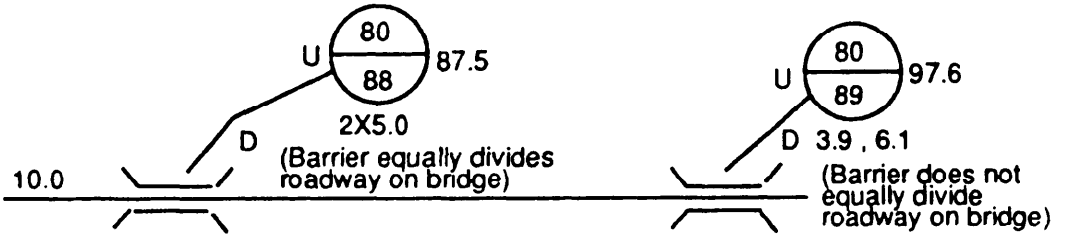


FIGURE 12. Bridges with dividers or barriers.

3.12.8.4.4 Bridge lengths (Used by both bridge types).

a. On most bridges two distinct lengths can be identified. First the overall length of the structure built to carry the transportation feature and second, the overall bridge length of the material actually carrying the transport surface over the crossed feature. On many older bridges these lengths will be or nearly be the same, but on many newer bridges they tend to be quite different. See Figures 13 and 14.

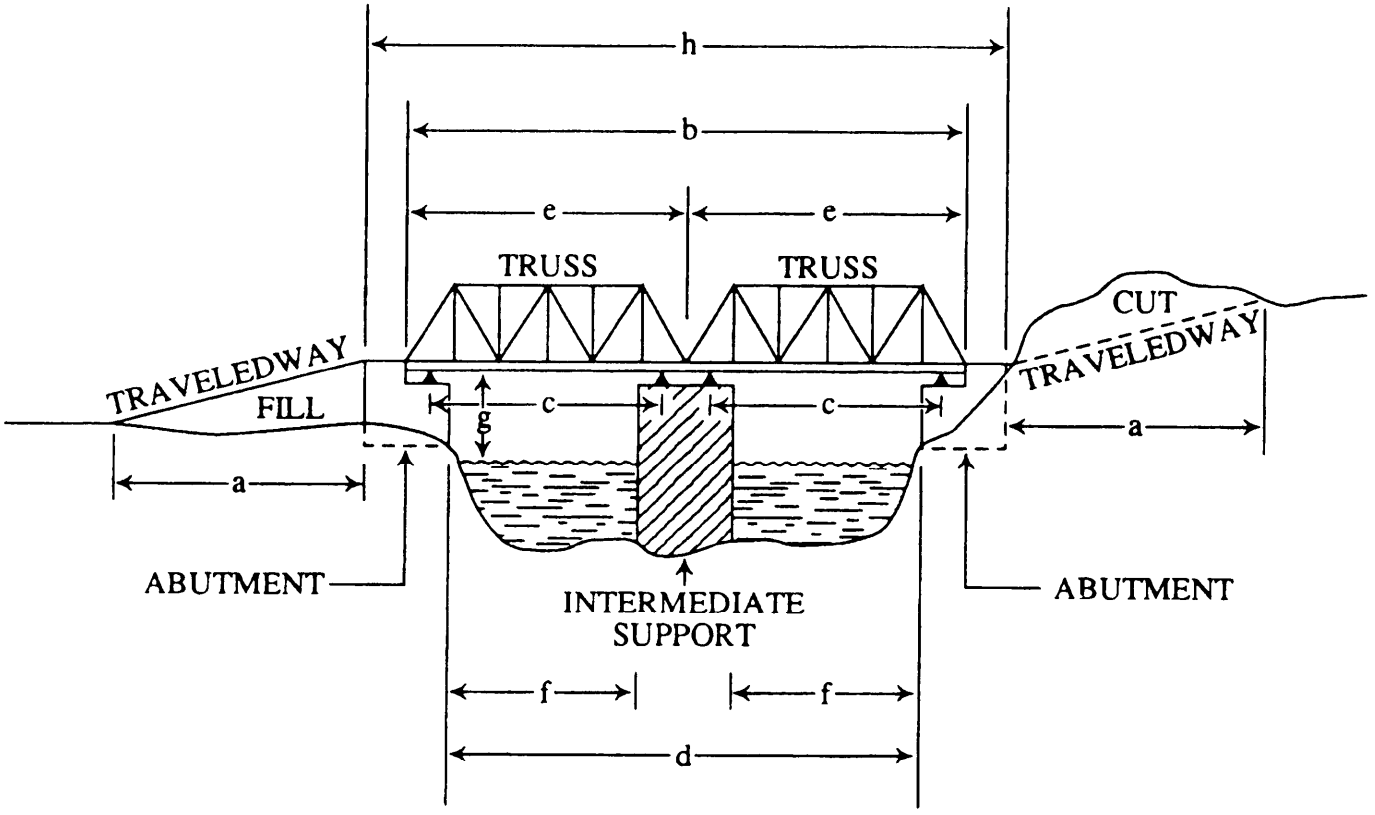
b. Overall Structure Length - The length of the man-made structure built to carry the transportation feature, including abutments, base fills, and extensions of the side walls. Approaches and other similar earth or gravel filled rises are excluded. The measurement is made along the centerline of the structure from where it meets the ground surface at one end to the other. This length corresponds to item "h" in Figure 13, Bridge Side View Nomenclature.

c. Overall Bridge Length.

(1) The overall length of a bridge is the distance between the extreme end points of the structure at the end walls/dams on the abutments. This measurement is taken along the bridge centerline, and does not include the length of the bridge approaches. Normally, it is slightly longer than the distance between abutments. (See Figure 13.)

(a) For road bridges the overall bridge length is the length of the bridge's traveled way surface supporting stringers, decking, or material (mostly slab and arch bridges) with end plates measured from the point where the bridge tread surface intersects with the roadway wearing surface at each end. This measurement is taken along the bridge centerline and does not include the length of the bridge approaches. It is slightly longer than the distance between abutments (see Figure 13). The value corresponds to "D" in the Road Bridge Information Holder section of the Transportation Legend (Appendix D, page 142).

(b) For railroad bridges the overall bridge length is the length of the bridge's track bed supporting stringers, decking, or material (mostly slab and arch bridges) with end plates measured between the points of intersection with the abutments. The value corresponds to "B" in the Railroad Bridge Information Holder section of the Transportation Legend (Appendix D, page 142).



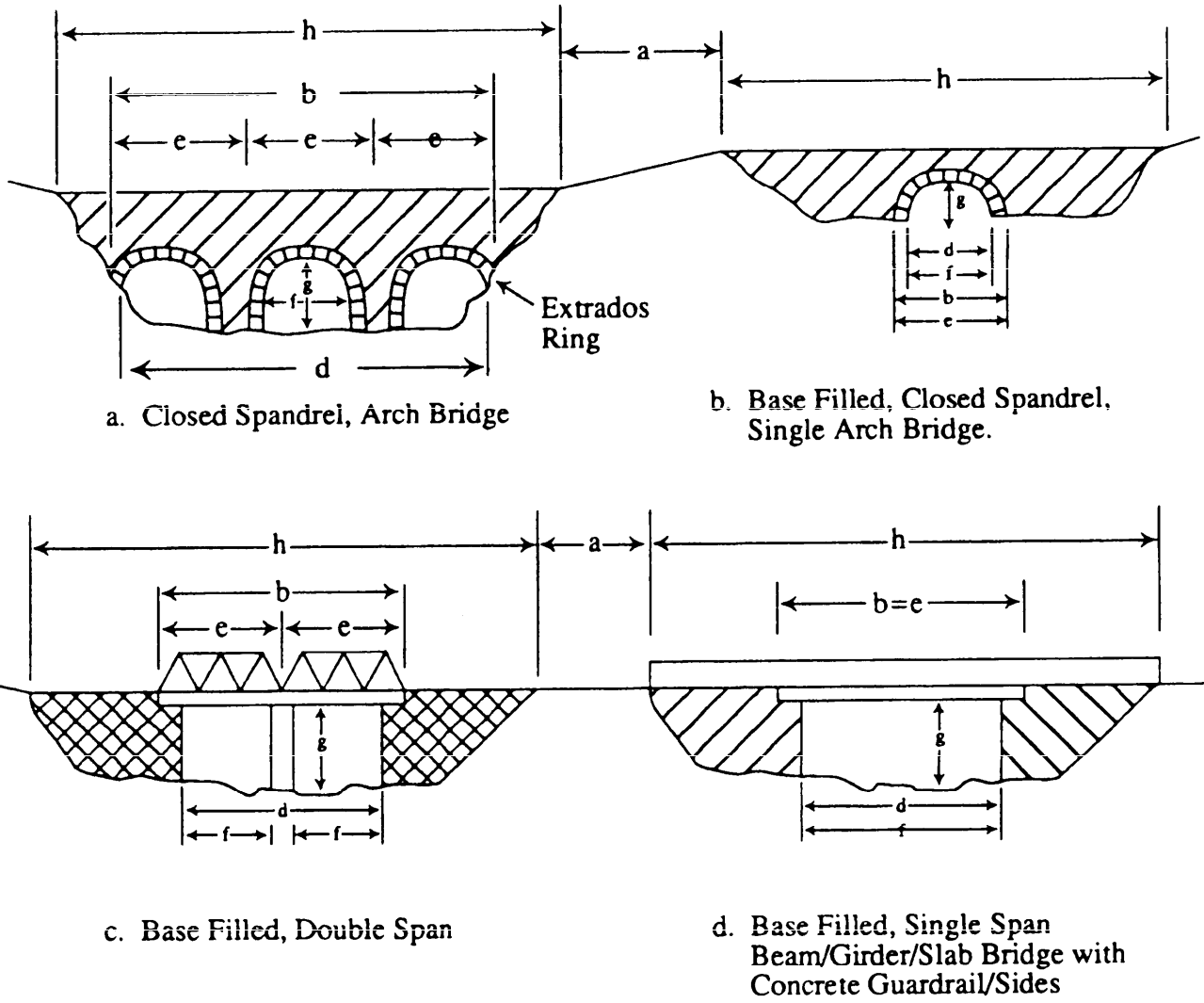
a = Approach
b = Overall Bridge Length
c = Span length, Bearing to Bearing
d = Length Abutment to Abutment
e = Span Length
f = Under Bridge Horizontal Clearance
g = Under Bridge Clearance
h = Overall Length of Built Structure

FIGURE 13. Bridge side view nomenclature.

(2) For many bridge types, such as closed spandrel arch or base filled bridges, there is no clear distinction between approaches, abutments, base fills, and/or spanning members or materials. While some of these have very clearly distinguished spans and overall length of spans, they also have associated sides, guardwalls, filled bases, abutments, etc., which extend beyond the actual spans. Since, for terrain analysis purposes, the ability to open gap or cross over an obstacle with proper clearances below is the most important reason for a bridge, only the open gapped distance, including any extrados ring(s), or length of crossing span(s) will be used as the overall bridge length. See the examples in Figure 14 (the letter codes are the same as those in Figure 13). Note that for these bridges, the overall length of the built structure usually will be much greater than the overall bridge length.

3.12.8.4.5 Bridge bypass potential (Used by road bridges only).

a. A bridge bypass is a local detour along a specific route enabling traffic to avoid or circumvent an obstructed or destroyed bridge. The bridge bypass potential is used both as an indication of the level of engineering effort needed to prepare a site for a military unit to cross the bridged obstacle (stream, gully, ravine, sunken road, etc.) and as an estimate of the ability of an individual vehicle



a. Closed Spandrel, Arch Bridge

b. Base Filled, Closed Spandrel, Single Arch Bridge.

c. Base Filled, Double Span

d. Base Filled, Single Span Beam/Girder/Slab Bridge with Concrete Guardrail/Sides

FIGURE 14. Examples of structure and bridge length differences.

to cross the obstacle. The vehicle usually selected for estimating the bypass potential is a large wheeled vehicle, such as the US 2.5 ton, M-35A2, M36, or M211 truck (or NATO equivalent).

b. The probable detour or bypass site must be located within an area which extends no further than a 2km radial distance from each side of the specified bridge (see Transportation Legend, Appendix D, page 142). Bridges at any distance from the bridge receiving the bypass code **are not** considered in determining the bypass classification.

c. The following factors and conditions are considered when evaluating the bridge bypass potential:

(1) Site Drainage Characteristics:
(a) Bank heights and gradients
(b) Water velocity and depth

(c) Bottom materials
(d) Existing fords
(e) Denseness of vegetation along banks

(2) Off-route Approaches:
(a) Roughness of surface expression (e.g., the presence of boulders or incised gullies, etc.)
(b) Wet or soft ground (state of the ground or soil moisture)
(c) Vegetative cover (agriculture, forest, etc.)
(d) Presence and closeness of approaches
(e) Other off-road approach conditions to site

(3) On-Route Approaches:
(a) Closeness to site
(b) Type of road
(c) Fords
(d) Other on-route approach conditions to site

d. The three bypass potential categories and their codes are listed below. The codes correspond to "E" in the Transportation Legend (Road Bridge Information Holder).

(1) Bypass Easy (Code E) - The obstacle can be crossed within the 2km vicinity of the bridge without work to improve the bypass or crossing site. Reaching the bypass site must be easy. The surrounding terrain must be conducive to obstacle free travel either by road or cross-country movement.

(2) Bypass Difficult (Code D) - The obstacle can be crossed within the 2km vicinity of the bridge, but effort or work is required for preparing the bypass or crossing site and/or the surrounding terrain is difficult to traverse either by road or cross-country movement.

(3) Bypass Impossible (Code I) - The obstacle can only be crossed if repair to an existing bridge or construction of a new bridge is accomplished, or the bypass site is impossible to reach either by road or cross-country movement.

3.12.8.4.6 Bridge number (Used by road bridges only).

a. All road bridges on the Transportation Overlay(s) are given a unique bridge number. Numbering is consecutive and begins with road bridge number one in the northwest grid square of the UTM reference system and proceeds from left to right to the neatline on the east side of the overlay. The numbering continues consecutively in the same way starting back at the west neatline of the next line of UTM grid squares below those previously completed, as shown in Figure 15.

b. In the Transportation Legend (Appendix D, page 142) the bridge number corresponds to the letter "F" under Road Bridge Information Holder.

3.12.8.5 Adjustments to bridge symbology in cartographically crowded areas. In congested areas or places where it is not cartographically possible to position the full bridge symbol without displacing other transportation features, the following adjustments (as shown in Figure 16) to the bridge symbology and/or its depiction can made:

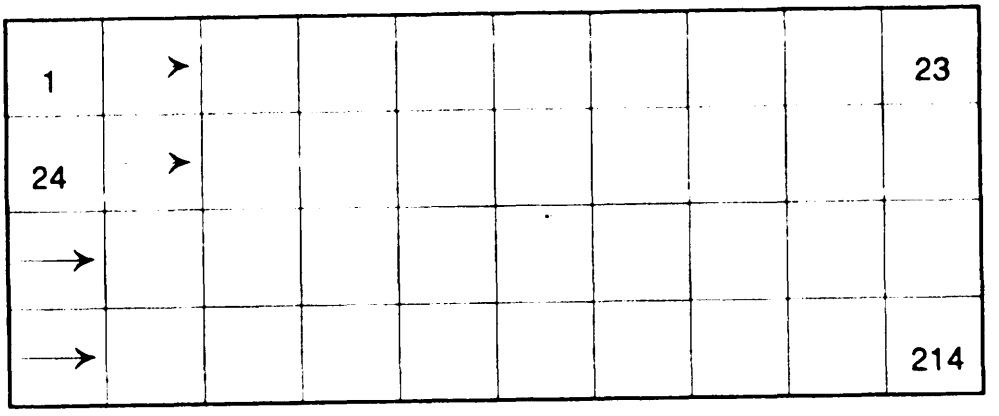


FIGURE 15. Example of the bridge numbering system.

a. Bridge wingticks on the congested side may be omitted, as illustrated in Figure 16b.

b. Where twin or more bridges are closely parallel to each other, a single line without wing ticks may be used to represent the adjacent bridge sides between them. See Figure 16c.

c. If the gap width between bridges does not allow even a single line for the bridge sides (0.25mm gap between bridge sides and transportation feature[s] is not possible), a single bridge symbol will represent both bridges. In this case, in order to indicate the twin bridges, separate bridge information holders shall be used on each side of the bridge symbol. See Figure 16e. Closely spaced, parallel, twin bridges along any road segment (regardless of whether the road itself is a divided highway) are each given a separate bridge number.

d. If cartographically necessary, an entire bridge symbol may be omitted. However, in congested areas, if the feature going under the bridge is also on the thematic overlay(s), it will be gapped with a 0.25mm space on each side of the overpassing feature to maintain the integrity of the bridging relationship,. A bridge information holder leader line shall point to the bridge's location. See Figure 16f.

e. Where consecutive bridges along a transportation route are so closely spaced that the bridge symbol wingticks overlap, the wingticks may be omitted. See Figure 16g.

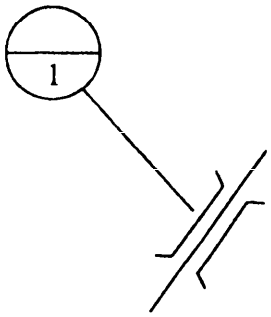
f. If consecutive bridges are within 2mm (100 meters ground distance) of each other, a single bridge symbol with separate bridge information holders pointing to their separate midpoints will be used. See Figure 16h.

3.12.9 Bridge Information Table

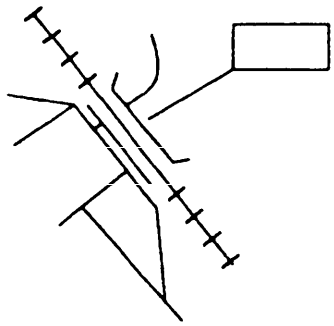
3.12.9.1 Use of the Bridge Information Table.

a. The Bridge Information Table (BIT, Appendix A, pages 111 through 113) is a systematic arrangement of road bridge data in sequential number order. A BIT is required whenever road bridges are identified on a corresponding Transportation Overlay.

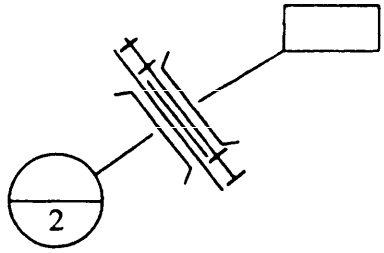
telephone number of the station and the routing indicator (RI) of



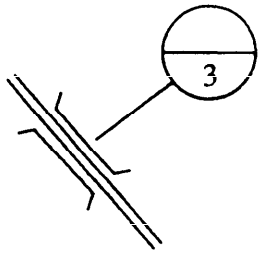
a. Regular Bridge Symbol.



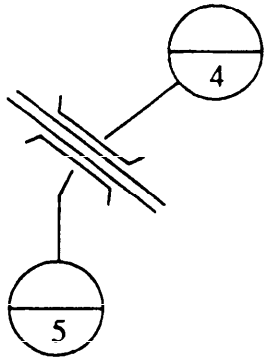
b. Omission of Wingticks on Congested Side.



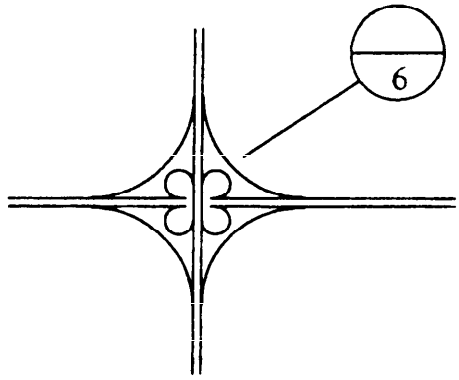
c. Single Line Representing Two Bridge Sides.



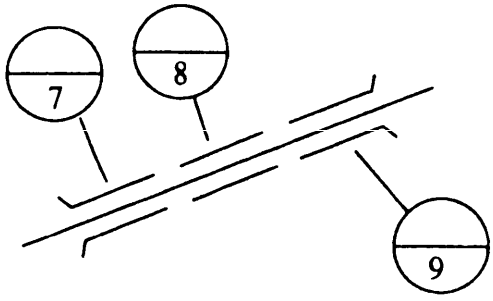
d. Single Bridge with Dual Highway.



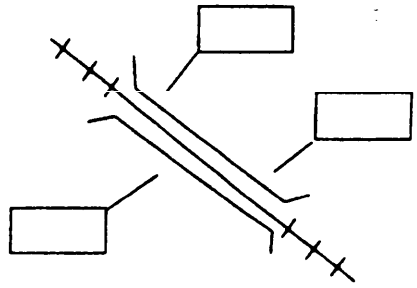
e. Twin Bridges on Narrowly Spaced Dual Highway.



f. Congested Area with Bridge Symbol No. 6 Omitted.



g. Clipped Wingtips on Closely Spaced Bridges.



h. Bridges within 100 meters of each other

FIGURE 16. Depiction of bridges in congested areas.

b. The BIT is normally produced as a separate overlay which supplements the bridge data shown on the Transportation Overlay(s). It carries all the same information, plus additional data, as the road bridge information holders. Data measured from the imagery is recorded to the nearest half meter (0.5m) increment; however, if more precise data from ground truth measurements or collateral sources are available, they will be shown in the BIT.

c. If space is available (usually large common open water areas - which are blank on the Transportation Overlay(s)), the BIT may be placed directly on the Transportation Overlay. Generally, the BIT is placed within the neatline; however, if it is small enough (five or less bridges), it may be placed outside the neatline in the margin in close proximity to the Transportation Legend. In either case, no part of the BIT may be positioned across the neatline.

d. If separate Transportation Overlays are produced for roads and railroads (with airfields) and space is available, the BIT may be placed individually on the Transportation (Roads) overlay. The rules for placement on the individual overlays are the same as specified in paragraphs b. and c. above.

e. If no road bridges are found on the Transportation Overlay, a Bridge Information Table will not be produced. A special note will be added to the Transportation Overlay(s) to alert the user that such a table does not exist for this set of TTADB thematic overlays. This special note will read as follows:

NOTE: Since no road bridges were identified along the road network shown on this sheet, a Bridge Information Table has not been produced.

3.12.9.2 Bridge Information Table attributes. The Bridge Information Table (BIT) will include the following road bridge attributes and characteristics.

3.12.9.2.1 Bridge number. (See 3.12.8.4.6.)

3.12.9.2.2 Universal Transverse Mercator (UTM) reference. The UTM reference is a six digit coordinate designation that locates the bridge site within a specific 100 meter grid square. The coordinates are obtained from a topographic map by starting in the south-west corner and moving to the right to read the Easting coordinate and then moving up to read the Northing coordinate (Army rule is to read coordinates "Right-up"). Each of the coordinates are recorded starting with the 10,000 meter number, then the 1,000 meter number, and ending with the 100 meter number. For example, a recording of 825672 would equal a UTM coordinate reading of 82,500 Easting and 67,200 Northing on the interior of the map sheet. Note that on 1:50,000 scale topographic maps the 10,000 and 1,000 meter numbers (the 82 and 67 in this example) are enlarged for easy reference, while the 1 million and 100,000 meter numbers in the margin are in small print and are not needed for reference inside the map sheet. The 100 meter numbers are read from a 1:50,000 grid scale.

3.12.9.2.3 Military load classification. (See 3.12.8.4.2). If available, the MLC will be listed for one and two way traffic for both wheeled and tracked vehicles.

3.12.9.2.4 Traveled way width. (See 3.12.8.4.3).

3.12.9.2.5 Overhead clearance. (See 3.12.8.4.1).

3.12.9.2.6 Number of spans. This is the total number of spans in a bridge. A span is that section of a bridge which (1) reaches from the intersection with the abutment on one side to the abutment on the other side (a single span bridge), (2) reaches from the abutment on one side to the center of an intermediate support, or (3) reaches from the center of one intermediate support to another.

3.12.9.2.7 Span construction material. This is a letter code listing of the known predominant construction material of the individual spans. If some spans are known to be predominantly of one material and other spans another material, both materials of span construction will be listed. See Figure 17, Sample Span Information Section of Bridge Information Table. The seven basic span construction materials recognized and their code letters are listed below:

Construction material of span		BIT code letter
a.	Concrete	(C)
b.	Masonry (Stone/Brick)	(M)
c.	Prestressed Concrete	(PC)
d.	Reinforced Concrete	(RC)
e.	Steel	(ST)
f.	Stone	(S)
g.	Wood	(W)

3.12.9.2.8. Span length (number of spans of specific lengths).

a. Span length is the bridge centerline distance from the intersection point of the load carrying spanning members or surface with end plate(s) at the end wall/dam on the abutment at one end to: (see Figures 13 and 14)

(1) The other end point - for single span bridges,

(2) The center of the first adjacent intermediate support - for the end spans of a multi-span bridge,

(3) The center of one support to the center of the next - for the inner spans of a multi-span bridge.

b. This is the span length which must be replaced if the span is removed. The sum of the span lengths equals the overall bridge length. See item "e" (span length) in Figure 13, Bridge Side View Nomenclature. This span length is the one most often generated from the sources available to produce the TTADB.

c. Some engineers prefer and report the bearing to bearing length of spans. This figure is used to calculate the military load classification. It is not usually available in the collateral sources and can only be collected by field check methods. If known, it shall be shown in parentheses immediately following the span length measurement or in parentheses by itself, if the span length measurement is not known. This length corresponds to item "c" (span length, bearing to bearing) in Figure 13, Bridge Side View Nomenclature.

d. For arch bridges, the span length includes the outer edges of any extrados ring(s). See Figures 13 and 14.

e. Where several spans with the same construction material and/or lengths are found on a single bridge, they are grouped together as shown in Figure 17.

Bridge Number	Spans			Comments
	Construction Material	Length(s) (m)	Number of Spans	
5	C	6x29, 2x20 5x25, 1x8	14	(All span lengths known)
6	W	3x50 (49.5)	5	(Two span lengths unknown)
7		30, 18		(Total number of spans unknown)
8				(Nothing known about any spans)
9	C	2x(10.5),(15.6)	15	(Only three bearing to bearing span lengths known)

FIGURE 17. Sample span information section of bridge information table.

f. In the span length column the first number of the a x b sets represents the number of spans made of the same material with a length of b. Note that the known spans might not make up the total number of spans in the bridge. If information is not known, those spaces are left blank in the table. In certain cases information might be available for certain spans but their total number is not known.

g. Where known span lengths do not repeat, the data can be listed with commas without the a x b format.

3.12.9.2.9 Underbridge clearance (UBC). The underbridge clearance is the maximum distance from the bottom of the bridge superstructure to the water, land, or transportation feature below. The measurement is obtained from field check measurements or collateral sources. See Figure 18.

3.12.9.2.10 Bridge bypass potential (See 3.12.8.4.5).

3.12.9.2.11 Bridge length (See 3.12.8.4.4).

3.12.10 Depiction of tunnels (Symbols 631 and 632).

3.12.10.1 Definition and general use of tunnels.

a. A tunnel is a structure which allows horizontal or nearly horizontal passage of a road or railroad through or under an obstacle or obstruction. (See Figure 19.) Tunnels can be either lined with concrete, masonry blocks, or metal to strengthen the structure and prevent the falling of loose materials and the seepage of water or they can be cut through solid rock with no lining. At the portals or entrance/exit points some sort of facing is usually erected.

b. All tunnels that can be identified on the imagery or derived from current collateral sources are included on the Transportation Overlay. Tunnels

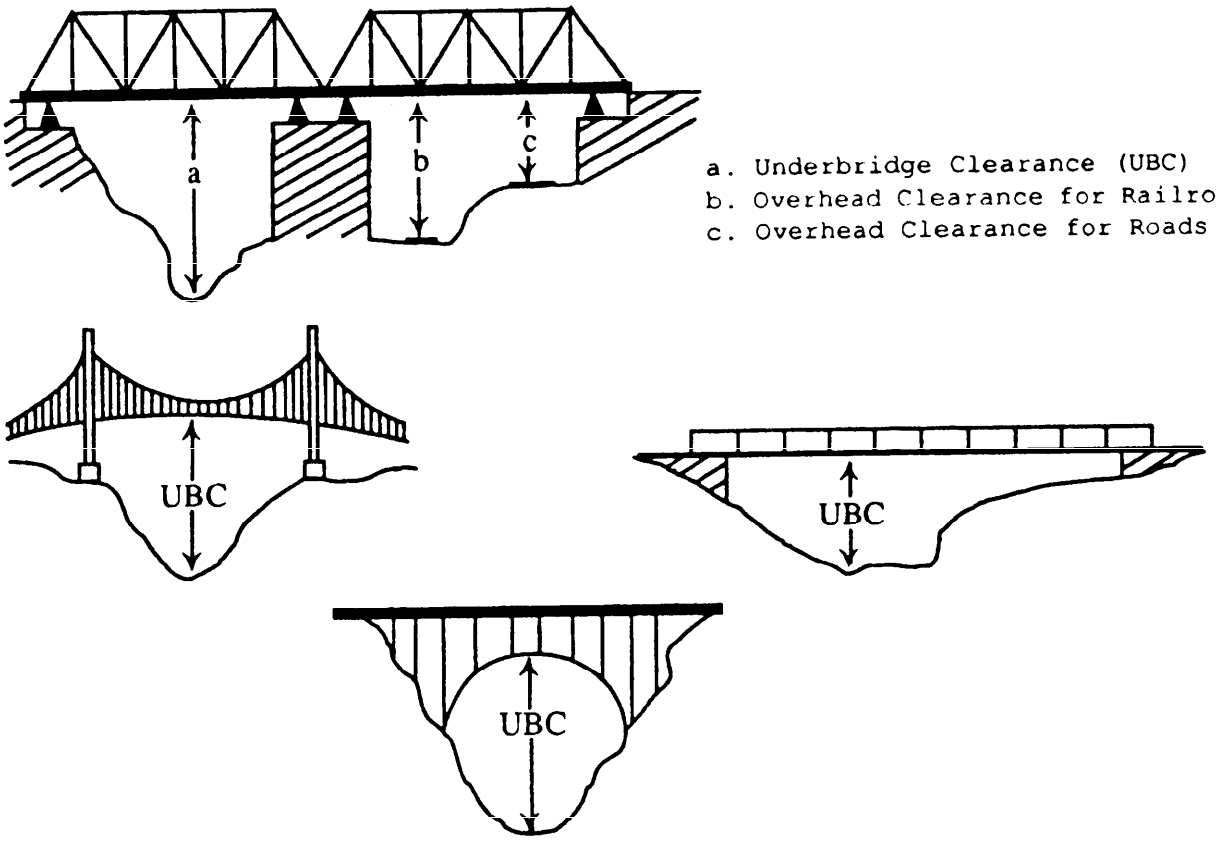
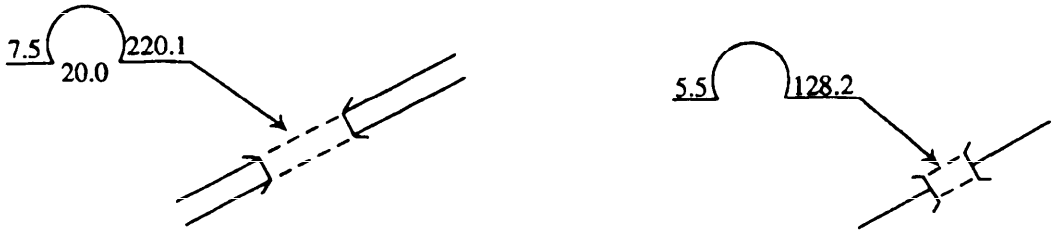
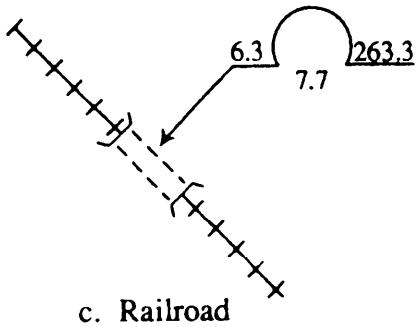


FIGURE 18. Examples of underbridge clearance (UBC).



a. Dual Lane Highway

b. Road/Highway



c. Railroad

FIGURE 19. Examples of tunnels.

less than 2mm (100m ground distance) in length shall be treated as point features and depicted with a minimum size tunnel symbol (Symbol 631); whereas tunnels greater than or equal to 2mm (100m ground distance) will be treated as linear features and plotted "to scale" using a minimum size width, if necessary and a true "to scale" length. Wider linear tunnels will be plotted "to scale" in both length and width.

c. Since no distinction is made for the type of feature carried through a tunnel (road or railroad), all tunnels use the same tunnel symbol (Symbol 631) and display the same attributes in their tunnel information holder (Symbol 632) All associated attributes measured from imagery will be shown in the tunnel information holders to the nearest half meter (0.5m). If available, more precise measurements from field check (on-the-ground) measurements or collateral sources shall be shown instead.

d. The tunnel symbol suppresses the road or railroad symbols where they are coincident. The transportation feature going through the tunnel is not shown, even if the data base holds them for feature continuity.

3.12.10.2 Tunnel attributes. The characteristics covered in the tunnel information holders are depicted in accordance with the legend, Appendix D, page 142 and symbolized as shown in Appendix B, page 123. Tunnels are assigned attribute measurement values or codes for (1) Height Clearance, (2) Width Clearance, and (3) Length.

3.12.10.2.1 Height or overhead clearance. The height or overhead clearance is the minimum usable vertical distance between the top of the transport surface and the highest part of the tunnel ceiling. For road tunnels the transport surface is the traveled way surface; for railroad tunnels it is the track bed or track supporting members. This height measurement is taken at the tunnel portal or opening. The height value corresponds to "A" in the Transportation Legend, (Tunnel Data). See Appendix D, page 142.

3.12.10.2.2 Width or horizontal clearance. The width or horizontal clearance is the minimum usable width of the tunnel bore measured above the transport surface horizontally from the inner side of one wall, guardrail, or raised walkway to the other. The measurement is made perpendicular to the tunnel length centerline. The width value corresponds to "B" in the Transportation Legend, (Tunnel Data). See Appendix D, page 142.

3.12.10.2.3 Tunnel length. Tunnel length is measured along the centerline of the tunnel's longitudinal axis from portal to portal or from one tunnel opening to the next. The value corresponds to "C" in the Transportation Legend, (Tunnel Data). See Appendix D, page 142.

3.12.11 Depiction of drop gates.

3.12.11.1 Definition and use of drop gates.

a. A dropgate is a massive assemblage of material, usually in the form of concrete logs or blocks, positioned alongside or over a transportation route (road or railroad) as a potential barrier to an advancing enemy ground force. They are generally tied into large fortified embankments on both sides of the transportation route to form part of a continuous defensive line when activated.

The supports holding the material in place are rather thin so they can easily be removed by an explosive charge, causing the material to fall onto the transportation route forming the desired barrier.

b. All dropgates associated with the portrayed transportation network that can be identified on the imagery or derived from either field check data or collateral sources are included on the thematic overlay(s). All dropgates are treated as point features and depicted in accordance with the legend, Appendix D, page 140, and symbolized as shown in Appendix B, pages 123 and 124.

3.12.11.2 Dropgate types. Two types of dropgates are distinguished from each other (See Figure 20):

a. **Side Dropgates** (Symbol 635) - Side dropgates occur where the material is positioned above and to one or both sides of the transportation route. When activated, the material, usually concrete logs, rolls and/or slides onto the transportation surface in a huge pile, where it prevents any further advance by the enemy without detouring around the blockage.

b. **Overhead Dropgates** (Symbol 636) - Overhead dropgates are usually massive concrete blocks placed directly over the transportation route. When activated they fall onto the transport surface, effectively blocking the passageway.

FIGURE 20. Depiction of dropgates.

3.12.12 Depiction of **ferries** (Symbol 612).

a. Ferrying sites are locations where human or vehicular traffic and cargo are conveyed across a river or other water barrier by a floating vehicle (e.g., a boat or barge) which is called a ferry.

b. All ferries along roads and railroads depicted on the Transportation Overlay shall be shown. Ferries along minor routes not selected as part of the representative road pattern will be omitted.

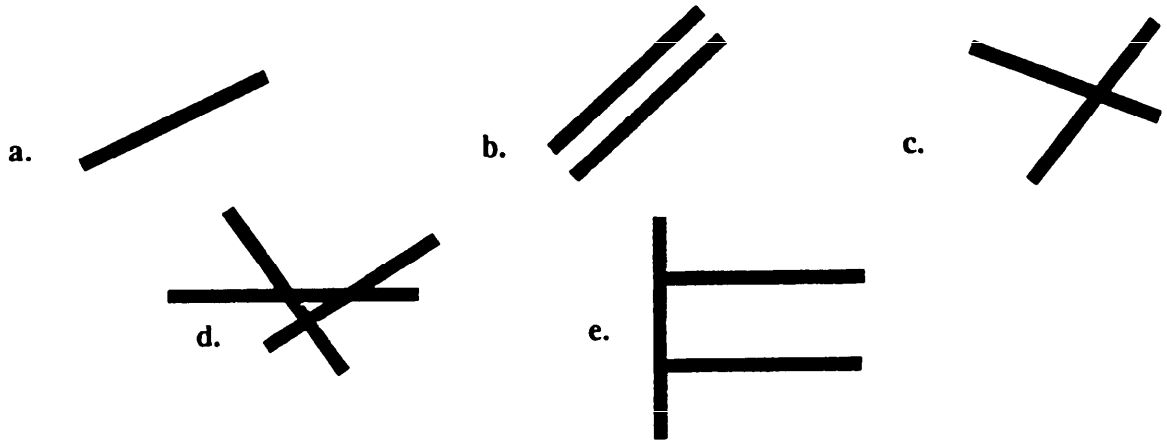
c. Road and railroad ferries are distinguished from each other solely by the type of transportation routes using them; however, no distinction will be made between passenger and freight ferries, or ferry types (cable, current-operated, or powered ferries).

d. The symbol for ferries is the word "ferry" placed either parallel to the southern neatline or parallel and above the center of the dashed line indicating the route of the ferry through the water body, if longer than 6mm (300m ground distance).

3.12.13 Depiction of **airport/airfield runways** (Symbol 638).

3.12.13.1 Treatment of runways.

a. All commercial, private and military airport/airfield runways are included as features for depiction. Runway orientations and patterns shall be depicted to scale the same as they actually exist on the ground (See Figure 21).



a. Single
b. Parallel
c. Dual Offset
d. Triple
e. Parallel and Offset

FIGURE 21. Runway orientations and patterns.

b. All runways that can be identified on the imagery or derived from current collateral sources are included on the Transportation Overlay. All runways are treated as linear features with a minimum length of greater than 2mm (100m ground distance) and a minimum width of 1mm (50m ground distance). Normally, the length of runways is plotted "to scale"; whereas the width is plotted "to scale" only if greater than 1mm (50m ground distance) wide.

c. All associated runway attribute values measured from imagery shall be shown to the nearest half meter (0.5m). If available, more precise measurements from field check (on-the-ground) measurements or collateral sources shall be shown instead. Taxiways, overruns, and stopway areas are not included in the measurements. The latter two are areas extending beyond the usable runways which are designed for emergency use only and whose subbase will not support the normal landing of aircraft.

3.12.13.2 Runway attributes. Runways are depicted with their true orientation and are assigned attribute measurement values or codes for (1) Runway length, (2) Runway width, and (3) Runway paving status. These three attributes are depicted in accordance with the Transportation Legend, Appendix D, page 143, and symbolized as shown in Appendix B, page 124.

3.12.13.2.1 Runway length.

a. For paved and marked runways, the length is taken from between the outer edges of the threshold markers at each end of the runway. A runway threshold is the designated beginning of the runway that is available and suitable for the landing of aircraft.

b. For paved but unmarked runways, the length is still only that portion of the runway that is available and suitable for the landing of aircraft. Overruns and stopway areas are not included.

c. The length of unpaved (usually grass covered) runways may include the runway overruns, unless imagery, field check data, or current collateral data provides more precise information that excludes them.

d. The measurement is made along the runway centerline and corresponds to "A" in the Airfield/Airport Runway Data Section of the Transportation Legend (Appendix D, page 143).

3.12.13.2.2 Runway width. The runway width measurement is taken perpendicular to the length centerline from one edge to the other. It corresponds to "B" in the Airfield/Airport Information Data section of Appendix D, page 143.

3.12.13.2.3 Runway paving status and orientation.

a. If the runway is paved, it is symbolized by the letter "P"; or if it is unpaved the runway is symbolized by the letter "U". These codes correspond to "C" in the Airfield/Airport Runway Data section of the legend.

b. The symbolized runway orientation (direction of the longitudinal axis) of the mapped feature shall exactly match that of the actual runway on the ground. Thus, the rectangular runway symbol (Symbol 638) must be shown in the same alignment as the actual runway.

3.12.13.3 Airport/airfield operational status.

3.12.13.3.1 Operational. Unless otherwise indicated, all airport and airfields associated with the depicted runways shall be considered operational (in use) and labelling as such is not required.

3.12.13.3.2 Non-operational labelling. If the airport/airfield or its runways are not operational, it shall be labelled below the paving status code with one of the following descriptive terms:

a. "Abandoned" - airport facilities and runway(s) still in existence but not in use, minimal effort required to restore to operational status.

b. "Non-operational" - facilities and runway(s) not in condition for landings and takeoffs, minor repairs are necessary before field can be made operational again.

c. "UC" - Under construction, special case, see 3.12.14 and Symbol 613.

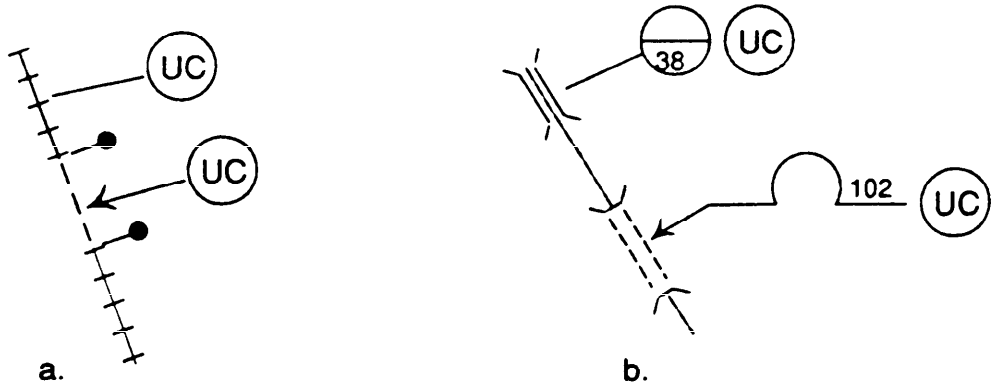
3.12.14 Depiction of features under construction. (Symbol 613).

3.12.14.1 Definition of features under construction. Features designated as under construction are those for which construction is actually underway. The under construction symbol is used to indicate which point or linear feature or segment is being built or rebuilt. Point of change symbols (Symbol 102) are used to show the extent or length of linear or areal features under construction.

3.12.14.2 Use of features under construction. The under construction symbol can be used in a number of ways:

a. All unidentified features which are under construction along a transportation route are symbolized with a circled "UC" (Symbol 613) and leader line pointing to the center of the point or linear segment. See Figure 22a. Unknown (neither identified or classified) linear segments shall be shown with a dashed line, using the fair weather, loose surface, road symbol (Symbol 603).

b. All features under construction that can be identified and classified shall be depicted with their standard symbol with a circled "UC" (Symbol 613) placed to the right of the feature symbol or data information holder. See Figure 22b.



a. Use of "UC" symbol for unclassified features under construction.
b. Use of "UC" symbol for classified features under construction.

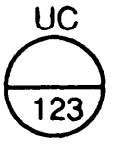
FIGURE 22. Use of under construction symbol for transportation features.

c. If the normal positioning of the data for an identified and classified linear segment is parallel to the transportation feature, such as road widths, then the circled "UC' symbol will be placed parallel and behind any labelling on the represented feature, space permitting.

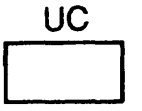
d. In areas with a high density of bridges where use of the circle "UC" symbol is cartographically unfeasible, just the letters "UC" in 7 point bold condensed type may be added to the bridge information holders in the positions shown in Figure 23.

3.12.15 Miscellaneous transportation features.

a. In some geographic settings, unique transportation features may be encountered which constitute important current and potential factors of signif-



a. Roads



b. Railroads

FIGURE 23. Use of "UC" with Bridge Information Holders.

icance to military operations along the transportation network. Such features as route segment vertical lifts, trails, overhead obstructions, restricted passages, snowsheds, canals, culverts, elevated transportation structures, etc. in certain environments and conditions may play a critical role in on-route operations. As some production systems can handle only a limited number of miscellaneous items on each of the thematic overlays, care must be taken to show only those that would have a major impact on military operations.

b. Unless specified below, depiction of these and or other similar features may require modification of the legend and/or symbology in order to provide unique symbology for the feature. Where possible, standard (as defined by this specification) letter or number transportation identification codes will be used. If the feature requires unique symbology, standard symbols from the Military Specifications for 1:50,000 Scale Topographic Maps of Foreign Areas (MIL-T-89301) will be used to the maximum extent possible.

c. Appendix I defines and specifies the symbology to be used for most of the miscellaneous features which have been occasionally added to the various thematic overlays since the first edition TTADB specifications (PS/3JB/010) were published in January 1982.

3.13 Hydrography. This section provides the basic guidance for the production of the Surface Drainage Overlay for the TTADB. All drainage features shown on the base map, as well as all other significant drainage features and/or changes found on later date imagery or collateral sources, including all channels with a military gap width greater than 4.5 meters, shall be shown on this thematic overlay. Drainage channels less than or equal to 4.5 meters that are not depicted on the base map will be shown only if they are a significant hindrance to the movement of main battle tanks (bank heights > 1.5 meters, bank slopes > 90 percent, and military gap width > 3.0 meters).

3.13.1 General surface drainage information.

3.13.1.1 Surface drainage symbology. Symbology for Surface Drainage is shown in Appendix B, pages 115 and 116.

3.13.1.2 Surface drainage legend.

a. Surface Drainage Legend categories and coding scheme are shown in Appendix D, pages 136 through 139.

b. The following diagrams and notes are to be included in the TTADB Surface Drainage Legend:

(1) Standard code notes tailored to the current project area for otherwise undesignated stream and canal segments.

(2) Swamps and marshes location note.

(3) Underlined bank height code note indicating dense vegetation.

(4) Coding, accuracy, and availability note.

(5) Note indicating that bank heights and slopes are read facing downstream.

(6) A statement keying the overlay to a specific climatic season.

(7) Additional notes to explain abnormal or irregular situations that occur on the specific overlay.

3.13.2 Depiction of features common to the surface drainage and other specified thematic overlays.

3.13.2.1 **Common open water areas**. (Symbol 103, labeled "W").

3.13.2.1.1 Open water definition. An open water area is any perennial body of water (ocean, lake, pond, reservoir, stream, river, etc.) large enough to be shown as an areal feature on the Surface Drainage Overlay. To be classified as a common open water area, the feature must be large enough, >= 20 square mm (50,000 square meters ground area), with a generally perennial water gap width of at least 1.0mm (50 meters ground distance) to be shown as an areal feature on the Surface Configuration (Slope), Surface Materials (Soils), and Vegetation Overlays.

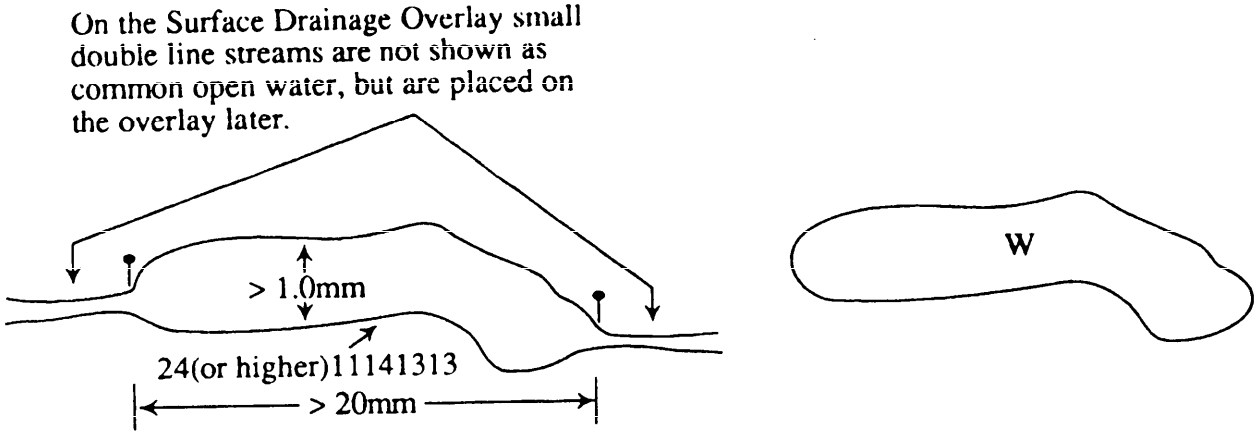
3.13.2.1.2 Depiction of common open water. The common open water areas depicted on the Surface Configuration (Slope), Surface Materials (Soils), and Vegetation Overlays will have identical outlines (line-for-line) with the common open water areas shown on the Surface Drainage Overlay.

3.13.2.1.3 Large rivers.

a. Rivers with a perennial water gap width greater than 1.0mm (50m ground distance) and a length greater than 20mm (1000m ground distance) are shown on the Surface Drainage Overlay as common open water, as illustrated in Figure 24. These rivers, greater than 50 meters wide, are classified and coded with the nine digit drainage coding system on the Surface Drainage Overlay only, as described in 3.13.5.

b. Rivers emptying into an ocean or large body of water, with a perennial water gap width greater than 1.0mm (50m ground distance) but a length less than 20mm (1000m ground distance) are considered inlets. These are labeled as common open water, by incorporating them into the shorelines mentioned in 3.13.2.2.1. See Figure 25.

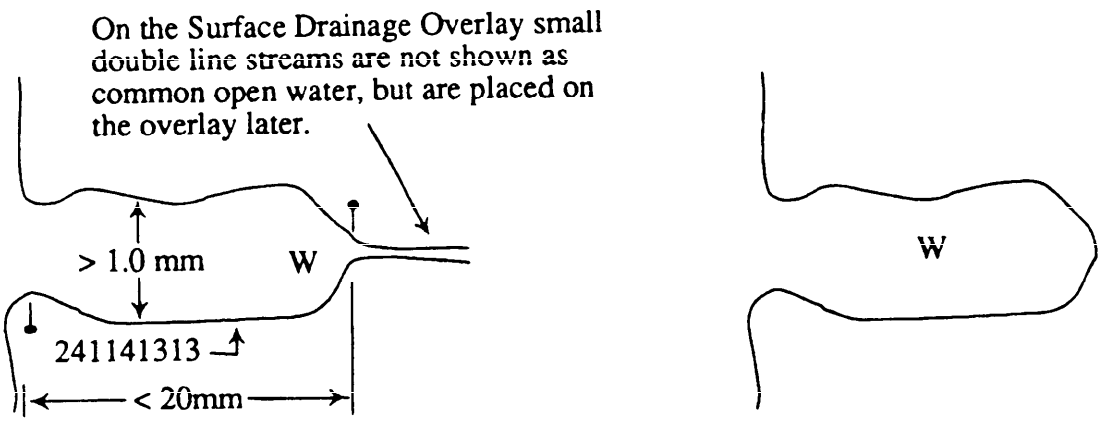
c. In order to prevent some perennial rivers from looking like a series of linear lakes on the Vegetation, Surface Materials (Soils), and Surface Configuration (Slope) Overlays, their common open water areas may be connected



a. Surface Drainage Overlay.

b. Surface Configuration, Surface Materials, and Vegetation Overlays.

FIGURE 24. Common open water, depiction of large rivers.



a. Surface Drainage Overlay.

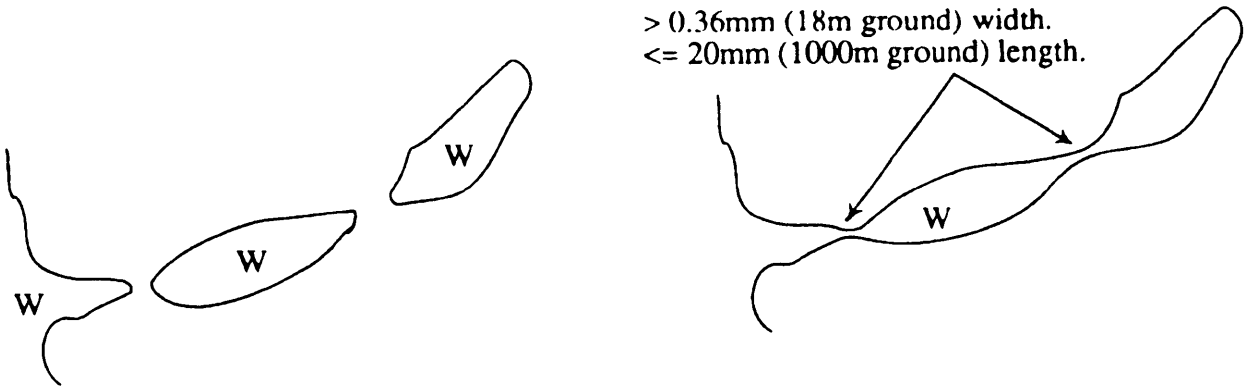
b. Surface Configuration, Surface Materials, and Vegetation Overlays.

FIGURE 25. Common open water formed by a shoreline.

as continuous common open water areas (Figure 26), if they meet the following requirements:

(1) The segments between the common open water areas have a perennial water gap width greater than 0.36mm (18m ground distance).

(2) The distance between the common open water areas is less than or equal to 20mm (1000m ground distance), as measured along the centerline of the drainage segment.



a. Discontinuities in the depiction of a large river

b. Common open water shown as continuous

FIGURE 26. Rivers shown as continuous common open water.

3.13.2.1.4 Large perennial lakes and reservoirs.

a. Perennial lakes and reservoirs are shown if they have an areal extent of at least 20 square millimeters (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance).

b. The outline of lakes and reservoirs (common open water features) shall be depicted to the fullest extent, where cartographically possible, not including flowing streams, but including areas or narrow fingers which are smaller than the minimum size limitations, as shown in Figure 27.

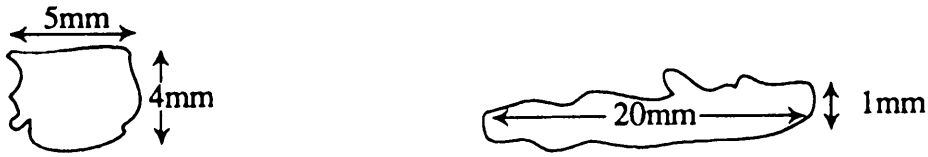


FIGURE 27. Common open water features outlines. (Not to scale)

3.13.2.2 Other common features.

3.13.2.2.1 Coastal shorelines. Coastal shorelines will be coincident with the base map unless significant changes have occurred. If there are significant changes, such as new port facilities or coastal land reclamation, these changes will be incorporated. A new shoreline based on the limits of land features at mean high water level will be delineated.

3.13.2.2.2 Offshore and inland islands.

a. Offshore and inland islands are shown if they are both completely surrounded by common open water features and have an areal extent of at least 20

square millimeters (50,000 square meters ground area) with a minimum width greater than 1mm (50m ground distance).

b. All islands shown on the Surface Drainage Overlay are actually areas of no water or "holes of no water" formed by the boundary of the common open water completely surrounding them.

3.13.2.3 Labelling of common open water areas. Common open water areas, excluding large rivers, are coded with a "W" on the Surface Drainage Overlay. Large rivers on the Surface Drainage Overlay are coded with a nine digit code, as described in paragraph 3.13.4. All common open water areas, including large rivers, are coded with a "W" on the Surface Configuration (Slope), Vegetation, and Surface Materials (Soils) Overlays.

3.13.3 Depiction of non-common open water features.

3.13.3.1 **Non-common open water areas** (Symbol 500).

3.13.3.1.1 Small open water areas. Small standing open water areas with an areal extent between 2 square millimeters (5000 square meters ground area) and 20 square millimeters (50,000 square meters ground area) with a minimum width of at least 1mm (50 meter ground distance) are considered non-common open water areas and are only shown on the Surface Drainage Overlay, as illustrated in Figure 28. These non-common open water areas do not appear on any of the other thematic overlays.

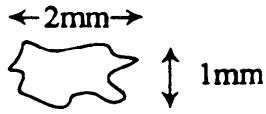


FIGURE 28. Minimum size of open water areas on drainage overlay. (Not to scale)

3.13.3.1.2 Lakes, ponds and reservoirs.

a. Lake - An inland body of standing water of considerable size occupying a large depression in the Earth's surface which is too deep for non-subaqueous vegetation to take root completely across the expanse of water. The water may be fresh or saline, and may be used as a source of water.

b. Pond - A natural or man-made small inland body of standing water occupying a small depression. The water may be fresh or saline, and may be used as a source of water, settling basin, etc.

c. Reservoir - An artificial inland body of standing water, generally of considerable size, formed by impoundment behind a dam. They are used as a place for the storage and control of water. Water is withdrawn for irrigation, water supply, flood control, recreation, or hydroelectric power generation. All reservoirs are considered open water features.

3.13.3.2 Labelling. All perennial non-common open water areas are coded with a capital "W" on the Surface Drainage Overlay. These non-common open water areas do not appear on any of the other thematic overlays.

3.13.3.3 Non-common small islands.

a. Small offshore and inland islands are shown if they are completely surrounded by open water areas and have an areal extent of at least 2 square millimeters (5000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance) and are less than the minimum size for common islands.

b. As with large islands, all small islands shown on this thematic overlay are actually areas of no water or "holes of no water" formed by the boundaries of the open water areas completely surrounding them. Islands formed by single line drainage channels are not considered in this category - they can be as small as the drainage pattern dictates.

3.13.4 Classification, depiction, and coding of flowing water and flowing water formed features. (This category includes Streams, Canals, Channelized Streams, Irrigation Canals, and Drainage Ditches)

3.13.4.1 Flowing water considerations. Consideration of flowing water features and their attributes (measurements) are limited to the extent of the present stream or canal channel within its existing normal limit of flood channel (high water mark).

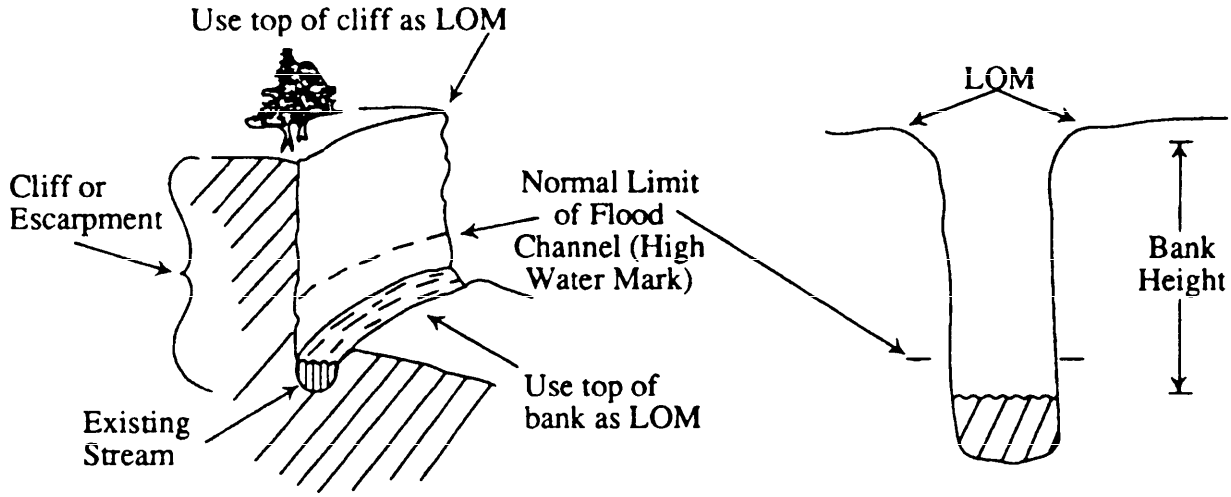
a. If the existing bank is a direct result of cutting by the existing stream, such as cliffs on the convex side of a bend or curve in the stream channel or a canyon cut straight down by the action of the water, the attributes will be measured to the top of the bank, line of measurement (LOM), even if the LOM is above the normal flood or high water limit line. See the examples in Figure 29. Streams may be perennial or intermittent.

b. If these vertical or nearly vertical banks (between 80 and 90 degrees from the horizontal) are greater than 5 meters high, they will also be picked up on the Obstacles Overlay as escarpments.

c. Bank slopes which are due to mountain erosion processes or slumped due to cave-ins or landslides filling in areas previously eroded by the existing or other stream regimens are not considered to be direct down-cutting by the present stream but are considered as gorges. See the illustration in Figure 30.

d. The normal case of a stream within its channel on a flood plain is shown in Figure 31. The inclined side of the natural terrace at the limit of the flood plain will be picked up on the Obstacles Overlay, if it meets the criteria for an obstacle.

e. Figures 29, 30 and 31 illustrate the relationships between lines of measurement (LOM), bank heights, flood plain limits, and normal limit of flood channels to be used in these cases. These limitations have been imposed in order to prevent gap widths (bridging distances) from becoming abnormally large, especially in steep mountainous or incised canyon and ravine areas.



a. One steep bank

b. Canyon/Gorge
Both banks steep

FIGURE 29. Stream cuts.

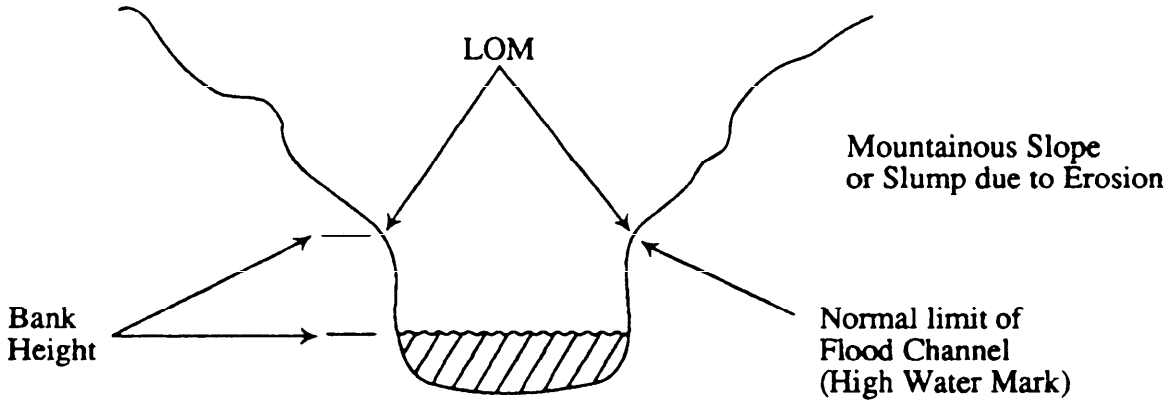


FIGURE 30. Streams within gorges in mountainous areas.

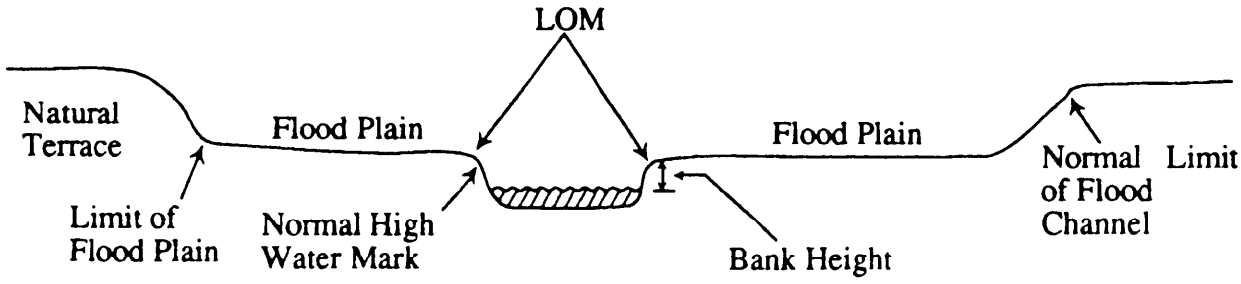


FIGURE 31. Normal case - stream channel within flood plain.

3.13.4.2 Military gap width.

a. Flowing water and flowing water formed drainage features are depicted on the Surface Drainage Overlay according to the distance of their military gap width. Military gap width is defined as the minimum horizontal bridging distance necessary to cross a water channel, perpendicular to the direction of water flow from bank to bank, measured at the first usable break in slope on each side of the channel above mean high water.

b. Usable banks are those accessible by military vehicles - small unusable ledges and cliffs are not considered usable breaks in slopes, as illustrated in Figure 32.

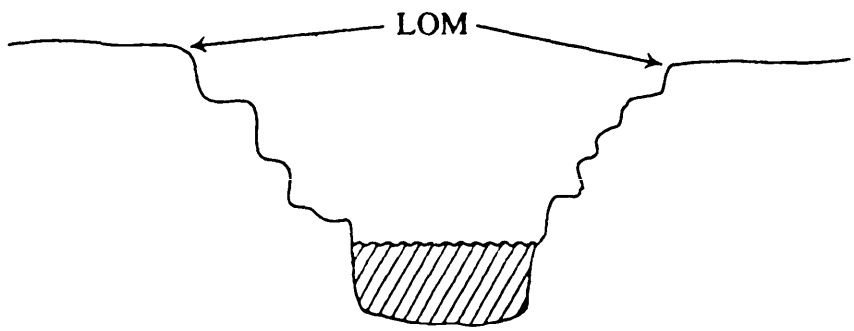


FIGURE 32. Depiction of small unusable ledges.

3.13.4.3 Flowing water features. The following features are depicted on the Surface Drainage Overlay according to the distance of their military gap width:

a. **Canal/Channelized Stream/Irrigation Canal/Drainage Ditch with gap width <= 4.5 meters** (Symbol 502).

b. **Stream with gap width <= 4.5 meters** (Symbol 503).

c. **Stream/Canal/Channelized Stream/Drainage Ditch with gap width > 4.5 meters and <= 18 meters** (Symbol 504).

d. **Stream/Canal with gap width > 18 meters** (Double line drains) (Symbol 505).

3.13.4.4 Coding flowing water features. Each segment of the above flowing water and flowing water formed features is classified and coded whenever cartographically possible. Point of change symbols (Symbol 102) are used to indicate the limits of each segment based on feature characteristic changes (see 3.13.7) at non-intersection points. Segments are classified and coded with a nine-digit code. Each digit represents a feature characteristic as defined below:

3.13.4.4.1 First digit - 123456789 - drainage feature type. All flowing water formed features (stream channels) are classified into the following types:

Drainage Feature Type		First Digit Code
a.	Intermittent or Ephemeral Stream	1
b.	Perennial Stream	2
c.	Stream Subject to Tidal Fluctuations	3
d.	Canal/Channelized Stream/ Irrigation Canal/Drainage Ditch	4
e.	Braided Stream	5
f.	Stream Channel In-Gorge	6

a. Stream - Any body of flowing water, great or small, moving under gravity flow to progressively lower levels in a relatively narrow but clearly defined channel on the surface of the ground. Especially such a body of water flowing in a natural channel.

(1) Intermittent or Ephemeral Stream (First digit is 1).

(a) Intermittent Stream - A stream or reach of a stream where the channel is below the water table for at least part of the year. It flows only when the available streamflow is fed by springs, a highwater table, precipitation or by some surface source, that is greater than the water losses from evaporation, seepage, or human withdrawal.

(b) Ephemeral Stream - A stream or reach of a stream where the channel is always above the water table. It flows only briefly as a direct result of precipitation in the immediate locality and whose channel is at all times above the water table.

(2) Perennial Stream (First Digit is a 2) - A stream or reach of a stream whose channel is almost always below the water table. It flows continuously throughout the year and is normally fed by both surface runoff and groundwater discharge.

(3) Stream Subject to Tidal Fluctuations (First digit is 3) - The portion of a stream or river which is influenced by the tide of the body of water into which it flows.

(4) Braided Stream (First digit is 5).

(a) A stream or portion of a stream that divides into an interlacing pattern of numerous, small, branching and reuniting, shallow water channels separated from each other by shifting branch islands or channel bars. These are highly susceptible to erosion and individual channels within the gap of the stream may shift from year to year. Braided streams may be perennial or intermittent.

(b) The gap width is taken as the bank to bank width across the entire braided stream flood channel, not just across the individual or larger interlacing channels which shift during floods within the braided portion. The entire gap width should be coded with the nine digit surface drainage code. Figure 33 illustrates the correct portrayal of braided streams on the Surface Drainage Overlay. If the banks are greater than 5 meters high they will also be picked up on the Obstacles Overlay.

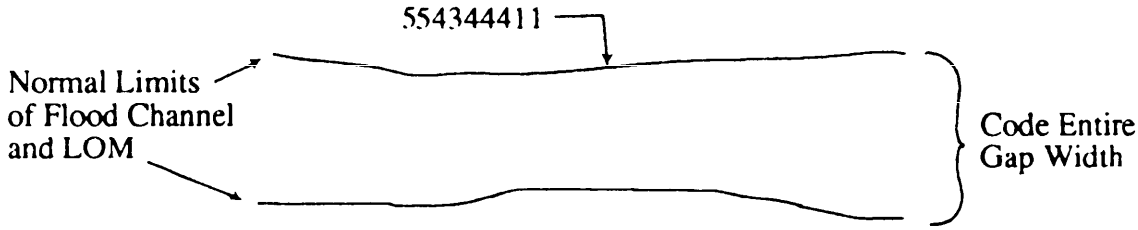


FIGURE 33. Portrayal of braided streams.

(5) Stream Channel In-Gorge (First digit is 6) - A stream or portion of a stream flowing through a deeply incised channel (deeper than 5.0 meters), generally small and narrow, with nearly vertical rocky walls that come right down to the water channel or the flood plain which is too narrow (less than 4.0 meters wide) to permit any military movement along side the stream. Ground access to the edge of the stream is either by water or by climbing or being lowered down the gorge walls. See the example in Figure 29b.

b. Canal/Channelized Stream/Irrigation Canal/Drainage Ditch (First digit is 4).

(1) Water course channels, generally man-made, that are used to control the direction and quantity of water flow. They can have relatively steep, paved, riprapped, or natural bank slopes and uniform dimensions which cut through an inland area.

(2) Canal - A water course of relatively large dimensions, usually water filled, designed for navigation, drainage or irrigation by connecting two or more bodies of water. Water flow and depth can be controlled.

(3) Channelized Stream - A stream which has been straightened or modified from its base alignment by man as an aid to navigation or to increase the flow rate of a stream or for flood control.

(4) Irrigation Canal - A normally small open channel, commonly with intermittent flow, carrying water to irrigate crops.

(5) Drainage Ditch - Normally a small, shallow, open waterway, channel, or trench constructed to control the direction of water flow and used for drainage or irrigation. These are smaller than irrigation canals.

3.13.4.4.2 Second digit - 123456789 - military gap width. The width of a stream, as defined in 3.13.4.2, measured from bank crest to bank crest. This measurement is independent of the width of water due to the dynamic nature of drains. Military gap width is the minimum horizontal bridging distance necessary to cross a water channel perpendicular to the direction of water flow from bank to bank, measured at the first usable break in slope on each side of the channel above mean high water. See Figure 32. The following width categories based on military bridging capabilities are used:

	Gap Width (Bank to Bank) (m)	Second Digit Code
a.	<=4.5	1
b.	>4.5 - 18	2
c.	>18 - 50	3
d.	>50 - 100	4
e.	>100 - 142	5
f.	>142	6

3.13.4.4.3 Third digit - 123456789 - bottom materials. Predominant material(s) of stream beds. The following categories are formed by grouping materials based on size using the Unified Soil Classification System:

	Bottom Material	Third Digit Code
a.	Clay and Silt	1
b.	Silty Sand	2
c.	Sand and Gravel	3
d.	Gravel and Cobble	4
e.	Rocks and Boulders	5
f.	Bedrock	6
g.	Paved	7

3.13.4.4.4 Fourth and fifth digits - 123456789 - bank heights and stream bank vegetation.

a. Bank Heights - Both banks (right 4th digit, left 5th digit) of a stream are measured and classified in categories significant to stream crossing operations. Bank height is defined as the vertical distance between the mean water level of the channel and the top of the first usable break in slope, measured at the same point on the upper bank as the military gap width. Right or left bank is identified by facing down stream (in the direction of flow). If a bank is greater than 5 meters high, with a slope greater than 90 percent, the bank must also be picked up on the Obstacles Overlay as an escarpment or embankment, as appropriate. The following bank height categories are used for both the right and left banks:

	Bank Height (m)	Fourth and Fifth Digit Code
a.	<=0.5	1
b.	>0.5 - 1.0	2
c.	>1.0 - 5.0	3
d.	>5.0	4

b. Dense Vegetation - Dense vegetation is defined as being thick brush or closely spaced trees which prohibits vehicles from entering or exiting a drainage channel. Examples include a single line of trees or a hedgerow thick enough to stop vehicular movement through it or it may be a part of a forest area as shown on the Vegetation Overlay. When dense vegetation is located on a stream bank for more than 50 percent of the segment length, it is indicated by underlining the 4th or 5th digit. (Example: 124334411).

3.13.4.4.5 Sixth and seventh digits - 123456789 - bank slope. The slopes of both banks (right 6th digit, left 7th digit) of a stream are measured and classified into percentage categories significant to stream crossing operations. Bank slope is defined as the angle of incline between the horizontal surface of the mean water level of the channel where it touches the bank and the top of the first usable break in slope, measured at the same point on the upper bank as the military gap width. As with bank heights "right" or "left" is determined by facing downstream (in the direction of flow). The following bank slope categories are used for both right and left banks:

Bank Slope (%)		Sixth and Seventh Digit Code
a.	<=30	1
b.	>30 - 45	2
c.	>45 - 60	3
d.	>60	4

3.13.4.4.6 Eighth digit - 123456789 - water velocity, average. Water velocity, speed of the current, is a dynamic characteristic and is estimated in meters per second (m/sec) with only two categories. Wide fluctuations in velocity preclude more precise classification. Rarely is collateral data available on stream velocity. Therefore velocity is estimated from stream and basin characteristics such as gradient, width, basin size etc. Average velocity is defined as the velocity that would normally be expected at mean water levels exclusive of high water due to runoff or low water due to drought. The two categories of water velocity are coded:

Water Velocity, Average (m/s)		Eighth Digit Code
a.	<=1.5	1
b.	>1.5	2

3.13.4.4.7 Ninth digit - 123456789 - water depth, average. Water depth for a stream segment is an estimated value in meters based on the characteristics of the stream. As with stream velocity, stream depths vary with flow and are estimated for normal flow at mean water levels. Four categories of water depth are coded:

Water Depth, Average (m)		Ninth Digit Code
a.	<=0.8	1
b.	>0.8 - 1.6	2
c.	>1.6 - 2.4	3
d.	>2.4	4

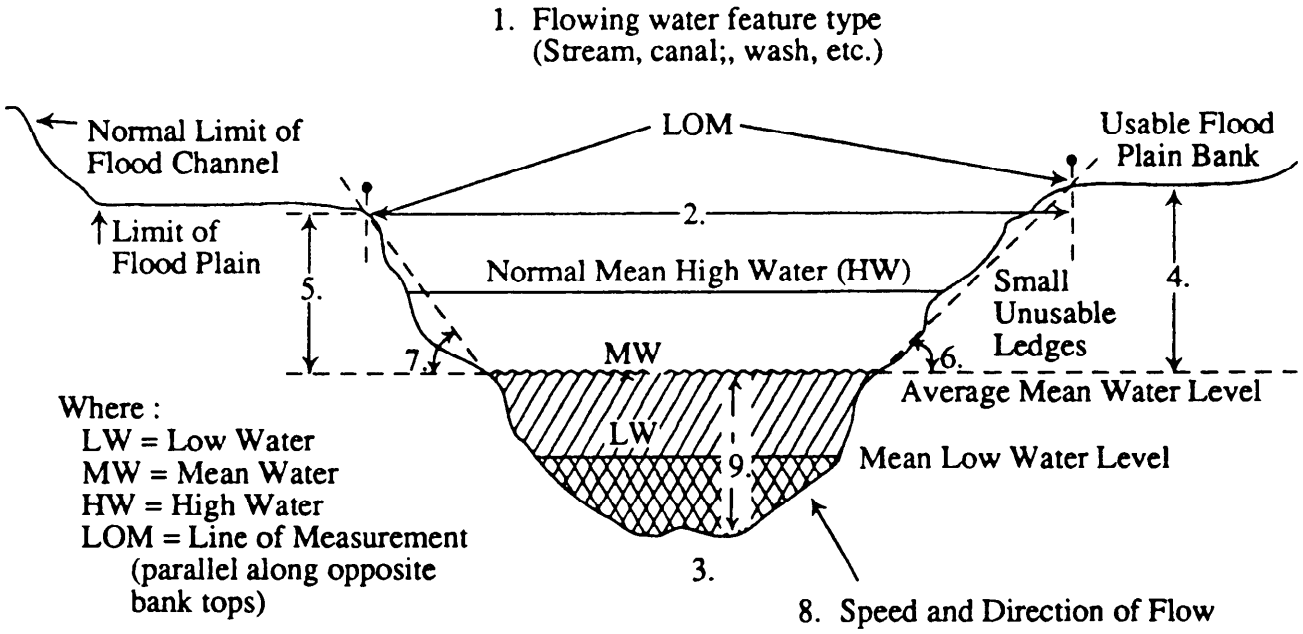
3.13.4.5 Standard codes.

a. Canals, channelized streams, irrigation canals, drainage ditches, and streams with gap widths less than or equal to 4.5 meters, unless designated otherwise, are assigned nine-digit standardized codes - one for canals and one for streams. Likewise, streams with gap widths greater than 4.5 meters to less than or equal to 18 meters, unless designated otherwise, are assigned a standardized nine digit code. Any of these features not tagged with a nine digit code on the

Surface Drainage Overlay is considered to be a standard coded feature. These standardized codes will not be shown within the neatlines of the map sheet or product area, but will appear in a legend note similar to sample notes 1, 2, and 3 in Appendix D, page 137. However, standard codes will be identified on the pencil compilation overlay as "SC".

. b. Determination of the standardized codes is made by simply counting the number of times each combination of code values would appear for eligible streams and canals. The combination with the highest count for each of the three eligible categories will be used for the standardized codes.

3.13.4.6 Stream cross-section. The typical stream cross-section, shown in Figure 34, clarifies the meaning of each member of the nine digit surface drainage code described above. The illustration shows and identifies each position in the code.



Digit	Feature Characteristic	Digit	Feature Characteristic
1.	Drainage Feature Type	6.	Right Bank Slope
2.	Military Gap Width	7.	Left Bank Slope
3.	Bottom Materials	8.	Average Water Velocity
4.	Right Bank Height	9.	Average Water Depth
5.	Left Bank Height		

FIGURE 34. Nine digit surface drainage code feature characteristics.

3.13.5 Depiction of the remaining surface drainage features.

3.13.5.1 List of remaining features. The following is a list of all remaining required features and their definitions to be shown on the Surface Drainage Overlay:

3.13.5.1.1 **Covered drainage** (Symbol 506).

a. A man-made drainage way (canal, irrigation ditch, aqueduct, etc.), completely covered over, connecting open drainage ways (including streams) at each end. Minimum length to be shown is 5mm (250m ground distance) and minimum ground width is 10 meters. Small streams and culverts less than 10 meters wide passing under roads, railroads, etc. are not shown, nor are naturally disappearing streams.

b. Minimum length distance will be measured from one opening to the other, unless collateral data indicating the true covered distance is available. The same applies to the alignment of the covered drainage way, it is assumed to be straight or smoothly curved unless collateral data indicates otherwise.

c. Covered drainage is depicted and labelled as such with a dashed line segment and point of change symbols, as necessary, to indicate where the segment begins and ends. (See Symbol 506.)

3.13.5.1.2 **Off-route fords** (Symbol 511).

a. Fords along minor roads that are not portrayed as on-route fords (paragraph 3.12.6.7.) in association with the representative pattern of roads shown on the Transportation Overlay will be portrayed as off-route fords. These off-route fords offer potential military crossing points and are depicted on this thematic overlay, if they are shown on the base map, are available from collateral sources, or are obvious on aerial photography.

b. These off-route fords usually have low inclined approaches in areas predominated by higher, more restrictive banks. Therefore, they are especially important along streams characterized by high (>= 1 meter), steep banks (greater than 60 percent), dense vegetation along one or both banks, or any combination of these attributes.

c. Since intermittent or ephemeral streams often flow primarily as flash rises and falls in water velocity and volume (like flash floods), in areas where non-selected transportation routes (roads) cross or run through them as off-route fords, a warning note stating, "Fords subject to sudden changes in water levels", will be added to the legend notes.

3.13.5.1.3 **Float bridge/raft sites** (Symbol 512).

a. Prepared sites on each side of a stream, generally of considerable size, where the banks have been engineered to provide a graded approach with either natural earth materials or paved surfaces leading into the water. These sites allow float bridges to be built or vehicle rafting operations to be conducted with no further engineering effort to prepare the approaches to the stream. They appear similar to and at very low water levels may even be used as fords.

b. All float bridge/raft sites are depicted with an open triangle (Symbol 512) on each side of the stream.

c. Where sites on opposite banks are not directly across from each other (angled channel crossing), the triangles on each bank should still point perpendicular to the tangent of the bank at their site.

3.13.5.1.4 **Dams** (Symbols 513 & 514).

a. Dam - An artificial or natural barrier or wall across a stream. For example a dam could be constructed for one or more of the following purposes: creating a reservoir for water storage, diverting water into a conduit or channel, creating a hydraulic head for power generation, improving stream navigation, controlling floods, or creating a sediment catchment basin.

(1) All dams are depicted with a dam symbol (Symbol 513).

(2) Dams greater than or equal to 5 meters high are portrayed with the regular dam symbol (Symbol 513) and an associated dam information holder (Symbol 514), which provides data on length, width across the crest, height (as measured vertically from the lowest point on the down stream side to the crest) and construction material. Construction material is shown in the following four categories:

Dam Information Holder Code	Construction Material
U	Unknown
C	Concrete
E	Earthwork
S	Stone

3.13.5.1.5 **Locks** (Symbols 516 & 517).

a. Lock - An enclosed structure in a canal, stream or dock with gates at each end and used to raise or lower boats and barges as they pass from one water level to another.

b. All locks are depicted with a lock symbol (Symbol 516) and the lock information holder (Symbol 517), which annotates the length and width. The points (closed gates) in the lock symbol face up-stream (the current or water pressure holds them shut).

c. Where a dam and lock combination occur adjacent to each other within the same gap width cross section, if necessary, the minimum size dam symbol will be displaced to its land side enough to allow the lock to be correctly positioned (Figure 35). Any transportation features crossing this combination will be shown as a road or railroad (on the dam) and a bridge (over the lock) on the Transportation Overlay.

d. If two locks along a drainage segment are too close together (less than 4mm [200m ground distance]) to show both locks, or if there are double locks at one point, only one lock symbol with a leader line connecting two lock information

holders will be used, even if the measurements are the same for both locks. (Figure 36.)

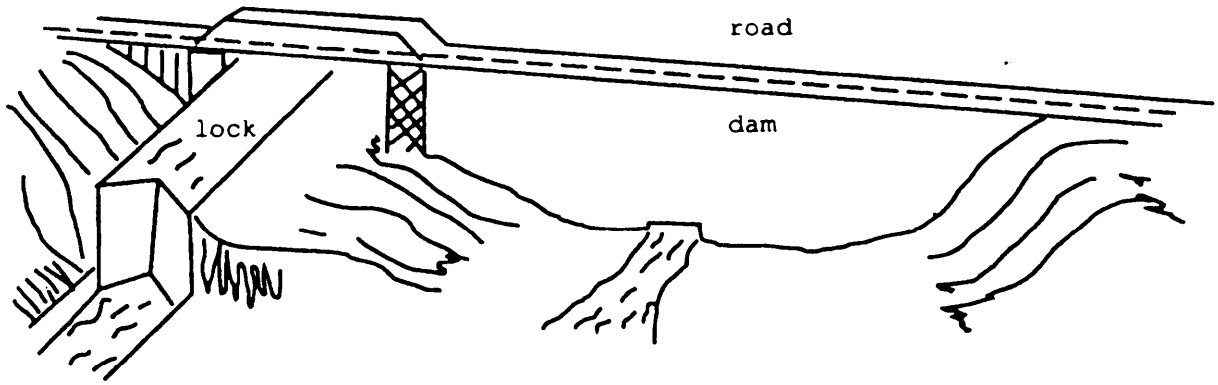


FIGURE 35. Road crossing over a dam and lock.

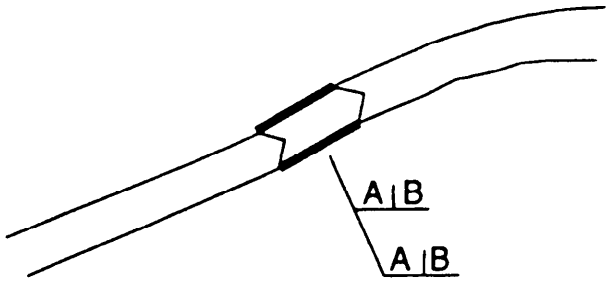


FIGURE 36. Multiple locks on a drainage segment.

3.13.5.2 Additional features. Additional features will be handled as per 3.13.8, Miscellaneous Surface Drainage Features.

3.13.6 Labelling surface drainage segments.

a. On the Surface Drainage Overlay, all flowing water surface drainage linear segments and double line streams shall be coded with a nine-digit code, except as noted in 3.13.6.c. The drainage codes shall be positioned to indicate the proper classification without making the overlay cartographically illegible. An example of proper classification depiction is shown in Figure 37. Dashed and lined stream segments without coding indicate standard codes as described in 3.13.4.5.

b. In order to improve legibility in crowded areas, one nine digit code may be used to identify multiple segments with the same characteristics by the use of multiple arrows, as illustrated in Figure 38. The number of arrows from a single nine digit code normally shall be limited to four, unless extreme density necessitates additional arrows.

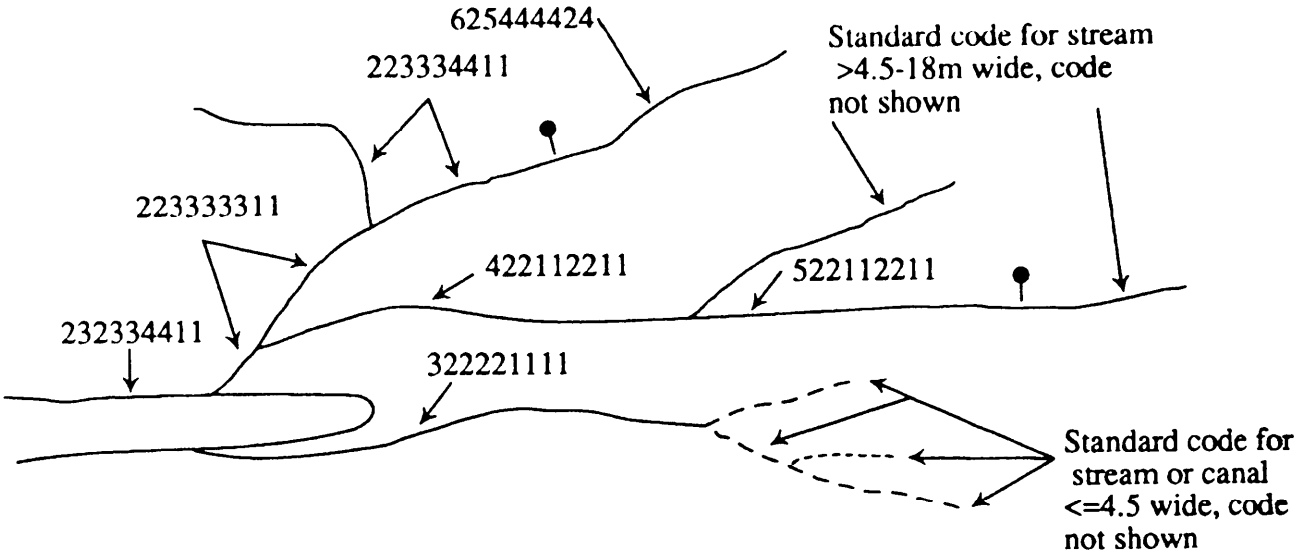


FIGURE 37. Stream segment labelling.

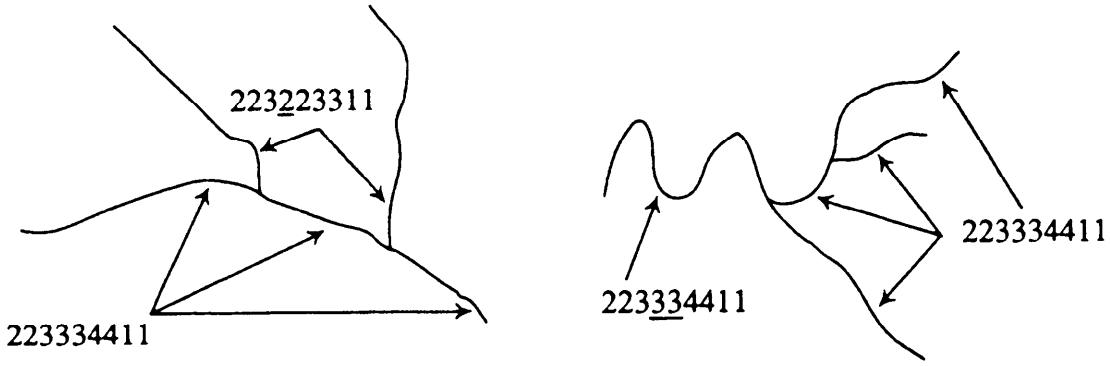


FIGURE 38. One code labelling multiple stream segments.

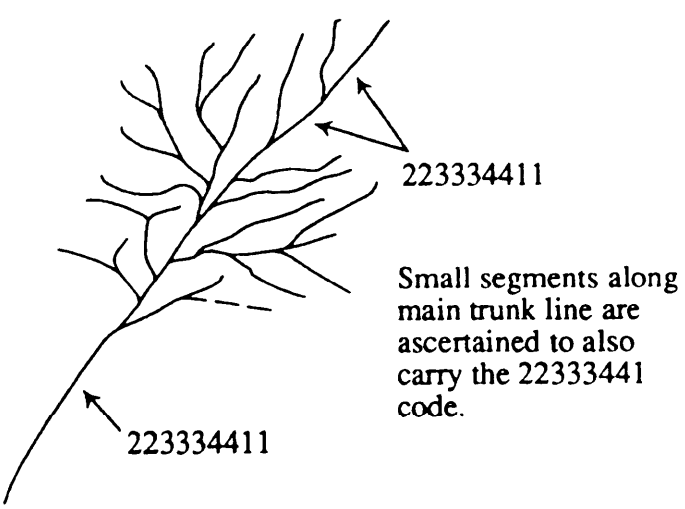
c. Where crowding or the sheer density and extent of drainage features cartographically prevents the coding of small segments, some exceptions to the normal rules are allowed:

(1) If the non-coded segments are on a trunk drainage line and lay between segments with the same code values, they will be ascertained to also carry the same code as the adjacent segments. See Figure 39a.

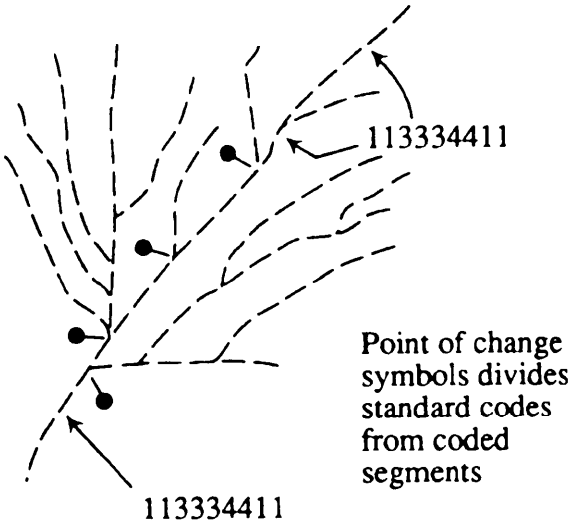
(2) Where the code for non-coded segments cannot be easily ascertained or could easily be mistaken as the standard code for small streams or canals, the situation will be clarified by:

(a) Use of point of change symbols. See Figure 39b.

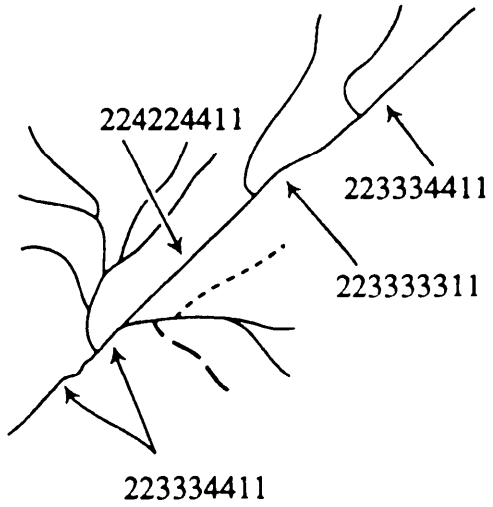
(b) The breaking of nearby small tributaries, canals or ditches to accommodate the nine digit code leader line with a gap of 0.5mm on each side. See Figure 39c.



a. Non-coded segments on trunk line between two like codes.



b. Clarification of coded segments from standard codes by use of point of change symbol.



c. Breaking and/or removal of small tributaries, canals, or ditches to accommodate leader line.

FIGURE 39. Labelling in cartographically crowded areas.

(c) The selective removal of small tributaries, canals, or ditches will be allowed as a last alternative, but only if those small drainage segments are less than 4.5 meters in gap width (second digit code number is a 1).

d. All codes, labels, descriptive notes, etc. on the Surface Drainage overlay will read left to right and be placed parallel to the center of the southern neatline.

3.13.7 Symbology and segmentation.

3.13.7.1 Symbol gap width. A gap of 0.25mm between symbols (including leader lines) and the lines of the surface drainage features will be maintained.

3.13.7.2 Segmentation.

a. On the Surface Drainage Overlay a segment is defined as an individual section of any flowing water symbol which carries a single nine digit classification code and is bounded by a point of change symbol, junction of like symbology, or its own terminus point(s).

b. Individual segments for linear features are formed at stream junctions (intersections), points of symbology change, where linear segments flow into areal drainage features (open water or double line streams), point of change symbols indicating stream characteristic changes, and at any other symbol which by its portrayal breaks the drainage line and thereby causes a change in either the drainage classification or in one of the nine coded characteristics.

c. Individual segments for areal drainage features are formed at point of change symbols (indicating stream characteristic changes), where areal features begin or end in linear segments, and at any other symbol which by its portrayal breaks across the width of the drainage symbol and thereby causes a change in either the drainage classification or in one of the nine coded characteristics. Areal drainage features do not have to be individually segmented for linear drainage coming into them from the side. (Illustrated in Figure 40.)

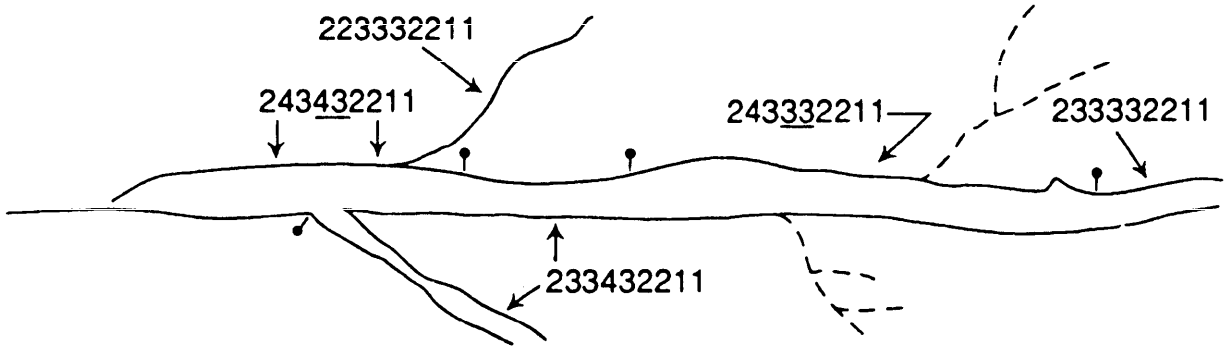
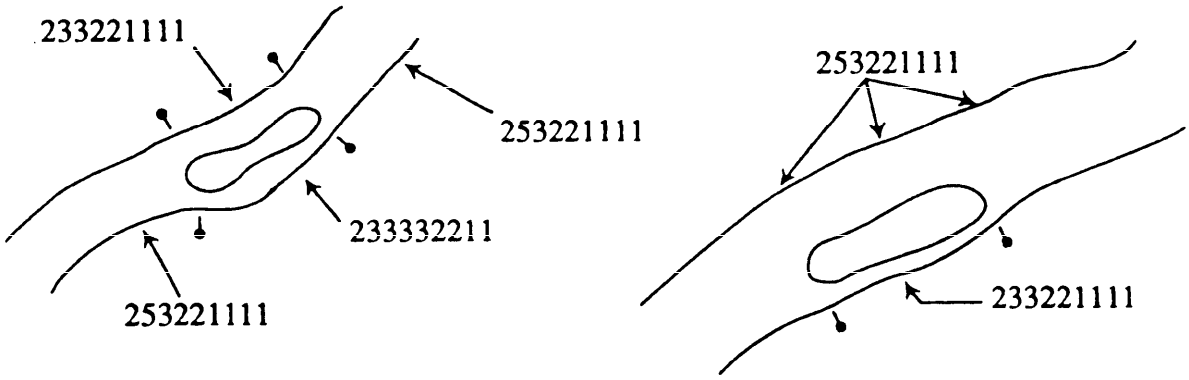


FIGURE 40. Segmentation and coding.

d. An island, larger than the minimum size (1mm by 2mm at map scale) located within a stream channel, shall cause the drainage symbol to be segmented and labelled as shown in Figure 41.



a. Both sides of the stream are divided into smaller segments.

b. Only one side of the stream is divided into a smaller segment.

FIGURE 41. Treatment of islands greater than minimum size.

e. A point of change symbol is needed only where there is no other boundary to mark a point of stream characteristic (code) change. The correct positioning for point of change markers is illustrated in Figure 42.

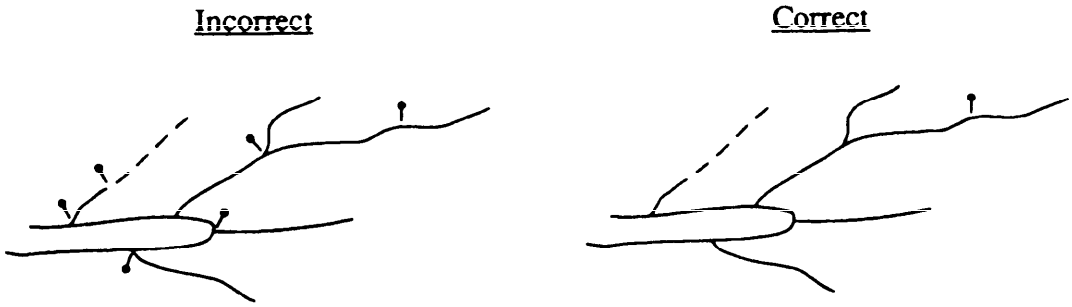


FIGURE 42. Correct positioning of point of change markers.

3.13.7.3 Drainage feature intersections.

a. Where drainage features less than or equal to 4.5 meters in gap width (large dashes for streams and small dashes for canals) intersect with either larger streams or canals or with the neatlines of a map sheet or product area dashed lines or dots should touch in order to indicate the streams confluence point or to indicate that the feature extends onto the adjoining sheet or product area, as shown in Figure 43.

b. Where the flowing water of a double line stream meets the standing water of an open water feature, point of change markers will be used to denote where the coded flowing water feature ends. A point of change symbol is not needed at the intersection of a single line stream or canal segment with an open water feature. Examples of these points can be seen in Figure 44.

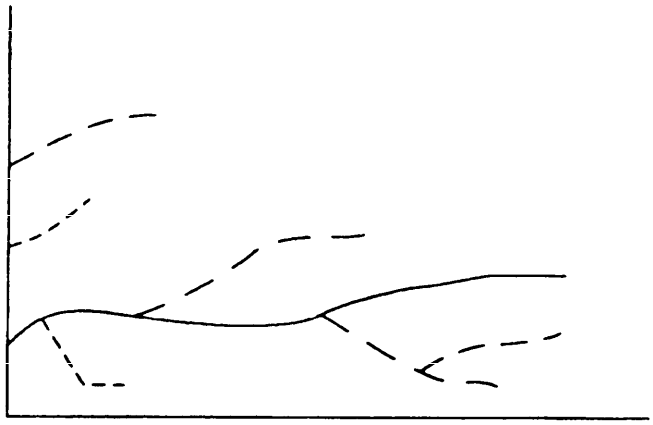


FIGURE 43. Drainage feature intersections.

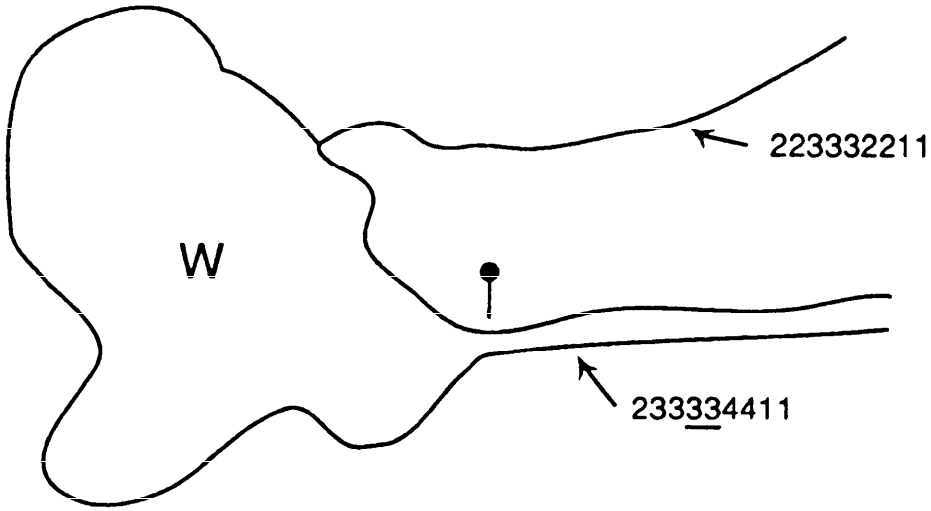


FIGURE 44. Treatment of intersections with open water.

3.13.8 Miscellaneous surface drainage features.

a. Additional surface drainage features may be encountered which are of major significance to military operations, especially river and channel crossings and/or landings. In some environments, features such as intermittent lakes, washes/wadis, anastomosing streams, aqueducts, tidal flats, weirs, features under construction, etc. may be of operational and landmark significance. As some production systems can handle only a limited number of miscellaneous items on each of the thematic overlays, care must be taken to show only those that would have a major impact on military operations.

b. Unless specified otherwise in Appendix I, depiction of these and or other similar features may require modification of the legend and/or symbology

in order to provide unique symbology of the feature. Where possible, standard (as defined by this specification) letter or number surface drainage polygon and linear identification codes will be used. If the feature requires unique symbology, standard symbols from Military Specifications for 1:50,000 Scale Topographic Maps of Foreign Areas (MIL-T-89301) will be used to the maximum extent possible.

c. Appendix I defines and specifies the symbology to be used for most of the miscellaneous features which have been occasionally used on the various thematic overlays since the first edition TTADB specifications (PS/3JB/010) were published in January 1982.

3.13.9 Lineal and areal extent.

a. Whereas surface drainage is represented by a lineal overlay with some areal features, all points within the neatline are not assigned map unit codes.

b. Tributaries must be greater than or equal to 5mm (250m ground distance) long or longer to be picked up.

c. For a stream to stand alone, where the stream does not flow into another stream, river, or body of water and has no tributaries flowing into it, the stream must be 5mm (250m ground distance) long or longer, unless it is a significant feature. Then a drain of a lesser length may be shown. See Figure 45.

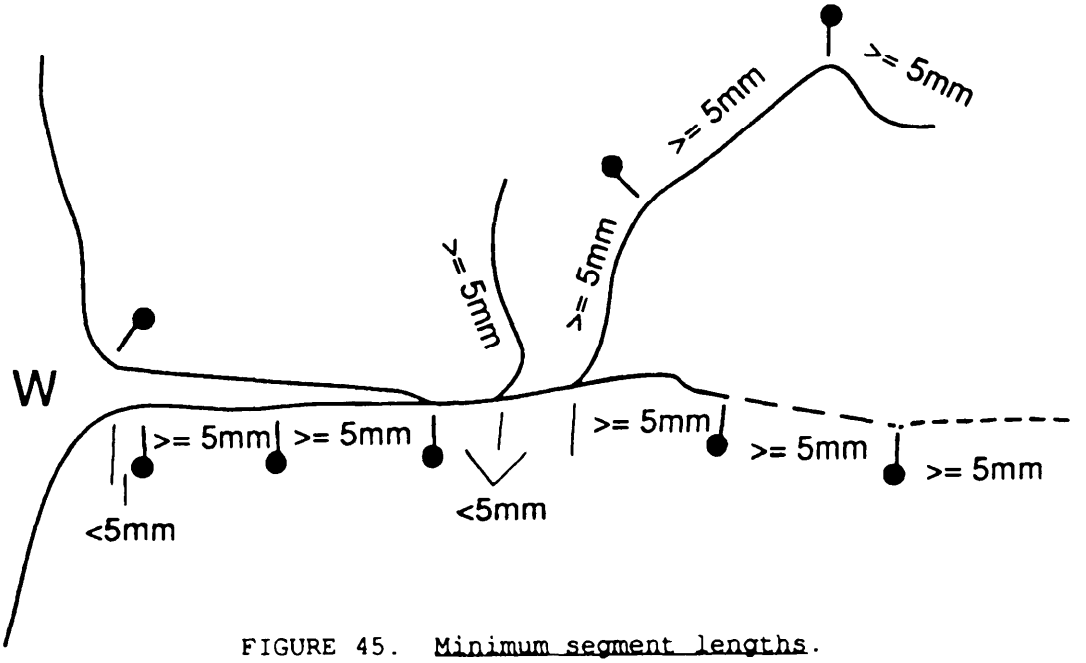


FIGURE 45. Minimum segment lengths.

d. The minimum drainage segment length as created solely by changes in the nine digit characteristics code is 5mm (250m ground distance).

e. The minimum size polygon for areal features shall have an areal extent of at least 2 square millimeters (5000 square meters ground area) with a minimum width of at least 1 millimeter (50m ground distance). As an example, an island smaller than minimum size (1x2mm) within a stream channel will not be shown or labelled on the Surface Drainage Overlay.

3.14 Hypsography/Physiography.

3.14.1 General slope information.

a. This section provides the basic guidance for the production of the Surface Configuration (Slope) Overlay for the TTADB.

b. Information shown on this overlay portrays the maximum slope of the surface at each point on the ground, expressed as percent slope (tangent of the slope angle x 100), rather than in degrees. Slope is defined as (1) ground whose surface forms an angle with the plane of the horizon (a natural or artificial incline) or (2) the degree or extent of deviation from the horizontal. Although there are an infinite number of slope values at a given point, the maximum slope is the critical limiting value for tactical military operations. Some microrelief information affecting movement of vehicles or foot troops is depicted on the Obstacles Overlay. Additional microrelief information is provided via the surface roughness factors on the Surface Materials Overlay.

c. Components of the Surface Configuration (Slope) Overlay are:

1. Slope Percentage Categories
2. Naturally and/or Culturally Dissected Land
3. Common Open Water Areas

d. The components of the Surface Configuration Overlay are derived from a variety of sources including the map contour plate, base map, slope maps, and an examination of the imagery.

e. A sample legend with map unit codes for the Surface Configuration (Slope) categories is provided in Appendix D, page 129. The lettered map unit codes are standardized and remain the same for all projects.

3.14.2 Slope classification and coding.

3.14.2.1 Slope classification.

3.14.2.1.1 **Slope categories** (Symbol 103, labeled "A" to "F" as listed below). The following slope percentage categories are portrayed on the Surface Configuration (Slope) Overlay:

Map Unit Code	Slope (%) Category
A	0 - 3
B	> 3 - 10
C	>10 - 20
D	>20 - 30
E	>30 - 45
F	>45

3.14.2.1.2 **Naturally and/or culturally dissected land** (Code Y).

a. Naturally and/or culturally dissected land (0 to > 45%) is a special case slope category. It represents a collection of individual slope categories covering the full range from zero to greater than 45 percent, each of which alone is below the minimum portrayal size, but which collectively form an area large enough to be portrayed in this special category. The use of this category is strictly limited to those cases where it is the only way to properly represent a range of heterogeneous slope categories in a small area. Its areal extent will normally cover only a small fraction of the overlay.

b. Some of the geomorphic phenomena likely to display this type of surface include:

(1) Numerous, very close, very steep, sand dunes;
(2) Portions of badland areas;
(3) Areas of very closely spaced mine tailings or spoil piles and/or mining waste areas;
(4) Cuts from strip mining;
(5) Large quarries;
(6) Numerous sink holes in karst areas;
(7) Recent and non-weathered lava flows;
(8) Extremely dissected terrain with dense drainage patterns;
(9) Steep-sloped canyons;
(10) Knob and kettle and hummocky terrain

3.14.2.1.3 **Common Open Water** (Code W). Common open water areas, as defined in 3.13.2, are depicted on the Surface Configuration (Slope) Overlay. These features are obtained from the Surface Drainage Overlay and are coincident with the open water areal outlines (match line for line) depicted on the Surface Materials (Soils) and Vegetation Overlays.

3.14.2.2 Slope coding.

a. Ground surface areas characterized by closely spaced slope polygons that are within one code difference and are too small to be individually depicted shall be collectively symbolized and coded as illustrated in Figure 46.

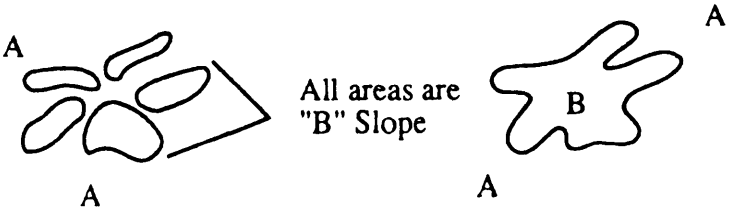


FIGURE 46. Slope coding of small areas differing by one code.

b. Ground surface areas characterized by closely spaced slope polygons that differ by two codes and are too small to be individually depicted shall be collectively symbolized and coded as illustrated in Figure 47.

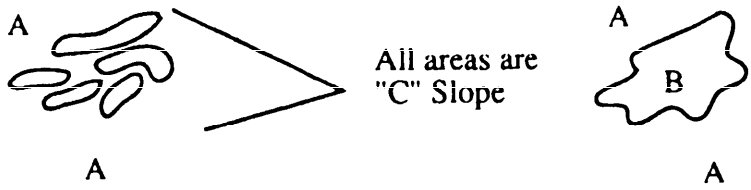


FIGURE 47. Slope coding of small areas differing by two codes.

c. Ground surface areas characterized by a variety of closely spaced slope polygons too small to be individually depicted shall be collectively symbolized and coded as illustrated in Figure 48.

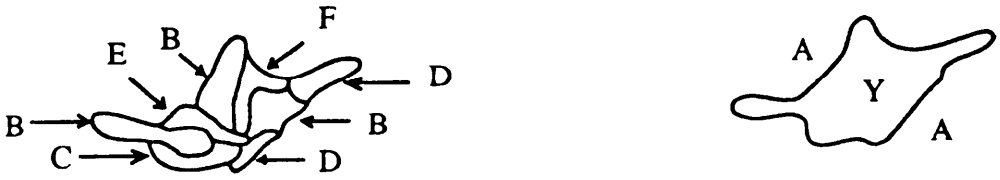


FIGURE 48. Slope coding of small areas with a variety of codes.

d. To clarify slope portrayal along shorelines at sea level, the measurement shall be made from the shoreline to the first contour line. This clarification shall be used only when classifying an area along the coasts of extensive bodies of water and not in relationship to lakes, ponds, reservoirs, large rivers, streams, canals, channelized streams and ditches.

3.14.3 Depiction of stream valleys and ridge lines.

3.14.3.1 Valleys.

a. Valleys with gently sloping floors or flood plains present some unique problems. Contour lines often do not depict a narrow valley accurately. However, they are important, because they may be the only avenues of approach into an area. The analyst should examine the source material and Surface Drainage Overlay.

b. If narrow valleys with smooth gently sloping floors or flood plains greater than or equal to 2mm (100m ground distance) wide exist, they shall be outlined on the overlay. (See Figure 49.) These will normally be a slope category A (0 to 3%), with some B's, and an occasional C or D possible.

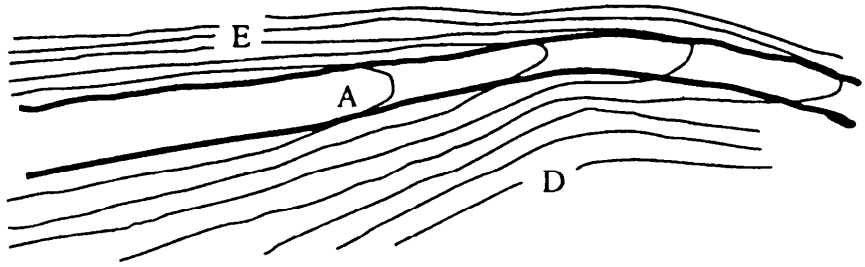
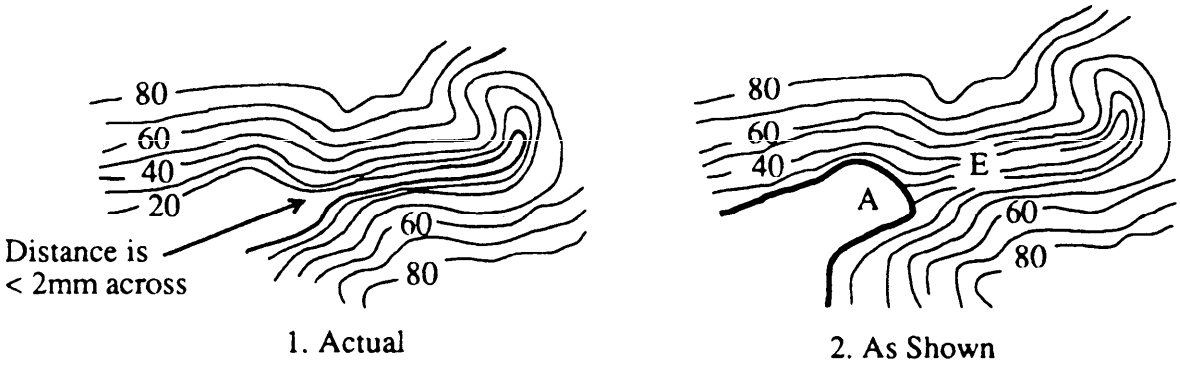


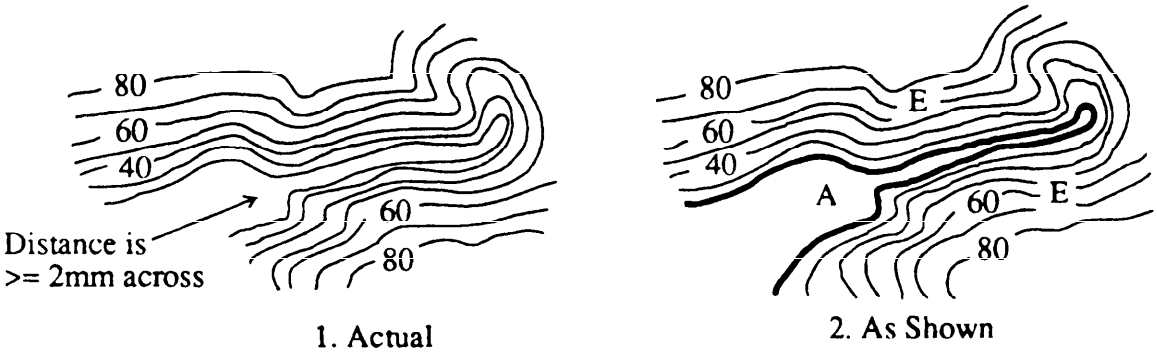
FIGURE 49. Narrow valleys with widths greater than or equal to 2mm (100m ground distance).

c. When the width narrows to less than 2mm (100m ground distance), the valley should be closed out and the remaining valley included with the categories derived by normal slope generation methods. (See Figure 50a.)

d. In situations where a valley feature extends into and terminates in a steep slope area, the feature shall be depicted to its fullest extent possible within the minimum size requirements, and is at least 2mm (100m ground distance) wide. (See Figure 50b.)



a. Narrow Valley whose Width is < 2mm (<100m ground distance).



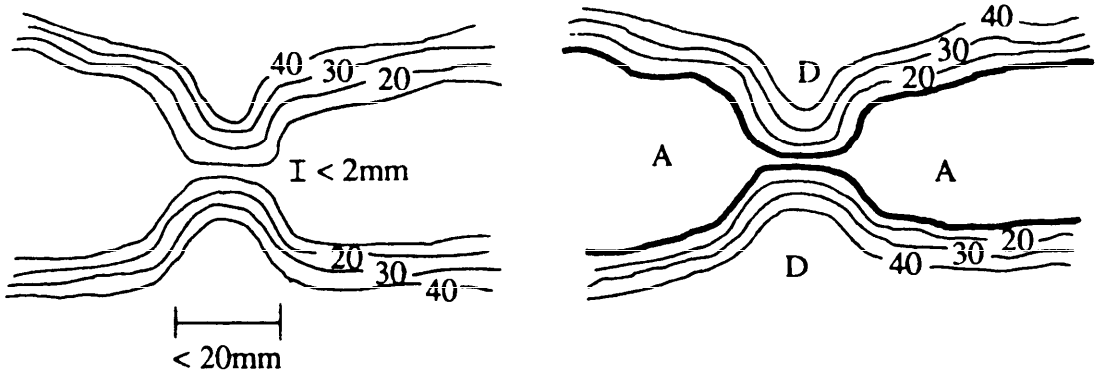
b. Narrow Valley whose Width is >= 2mm (>=100m ground distance).

FIGURE 50. Coding narrow valleys.

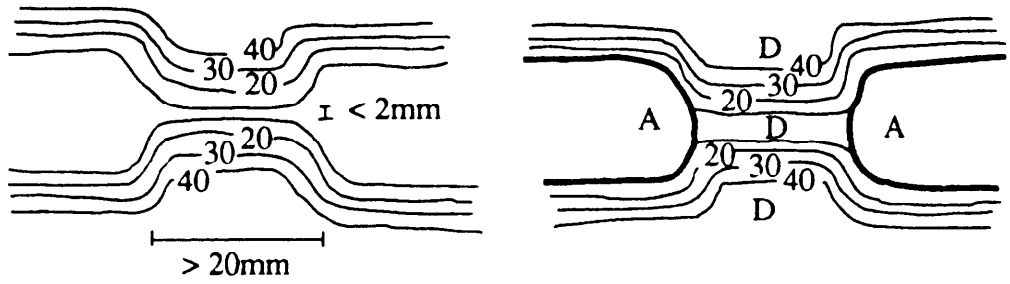
e. In situations where a narrow connection exists between wider valley areas not more than 20mm (<1000m ground distance) apart in length at map scale and narrows to less than 2mm but is still greater than 1mm (<100m and >50m ground distance) in width, the connection can be made to show the continuous avenue of approach. (See Figure 51a.) Where the wider areas are greater than or equal to 20mm (>=1000m ground distance) apart in length and the narrow connection is less than 2mm (<100m ground distance) in width at map scale , the connection shall be combined with the slope code for the higher side relief area. (See Figure 51b.)

3.14.3.2 Ridge lines.

a. Hilltops with long, thin, flat to gently sloping ridgelines represent another unique problem area. Contour lines often do not depict the sharpness of ridgelines accurately. If the source materials show that the top is part of a



a. Valley Connection <20mm in Length (<1000m ground distance) and > 1mm to 2 mm in Width (>50m to 100m ground distance)



b. Valley Connection >= 20mm in Length (>=1000m ground distance) and >1mm to 2mm in Width (>50m to <100m ground distance).

FIGURE 51. Narrow connections between valleys.

long flat ridge line greater than or equal to 2mm (100m ground distance) wide and more than 100mm (5000m ground distance) long and can be used as an avenue of approach, they shall be shown with a slope category A, with B's possible. While the minimum width specification is 2mm (100m ground distance), narrower connections less than 20mm long (1000m ground distance) (See valley examples in Figure 51) may also be shown. Figure 52 shows examples of smooth usable stream valleys and ridgelines.

b. In situations where a saddle or pass forms a low point on a ridge or crest line (generally a divide between the heads of streams, flowing in opposite directions) less than 20mm in length and less than 2mm in width at map scale (<1000m and < 100m ground distance), the slope shall be combined with the slope category depicting the two heads of streams. See the illustrated example in Figure 53.

c. In situations where a steep slope creates a sharp break in a relatively gentle slope between a valley floor and a saddle, the gentle or level slope code (Example: code A) shall be terminated at the break. The break is indicated by high density of contour lines compared to the valley/saddle contour lines on the open opposite side of the saddle; the valley slope coded area shall also end when the same contour lines are less than 2mm (<100m ground distance) apart at map scale. (See Figure 54).

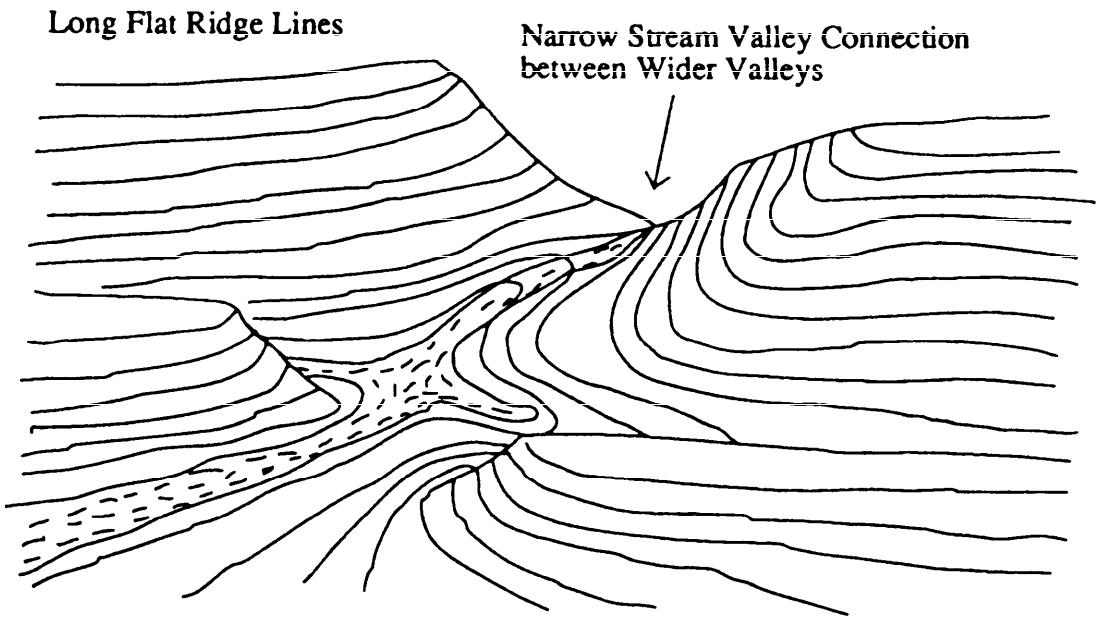


FIGURE 52. Smooth stream valleys and ridge lines.

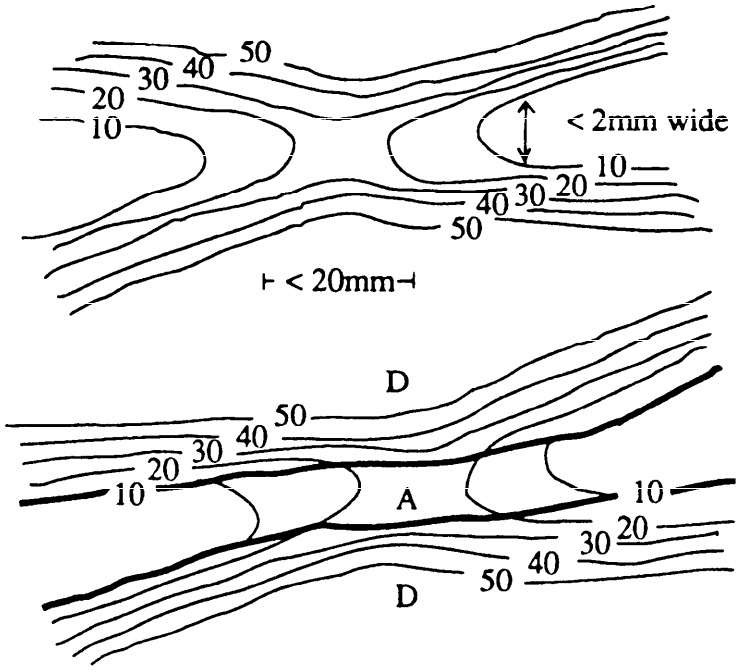


FIGURE 53. Depiction of a saddle/pass.

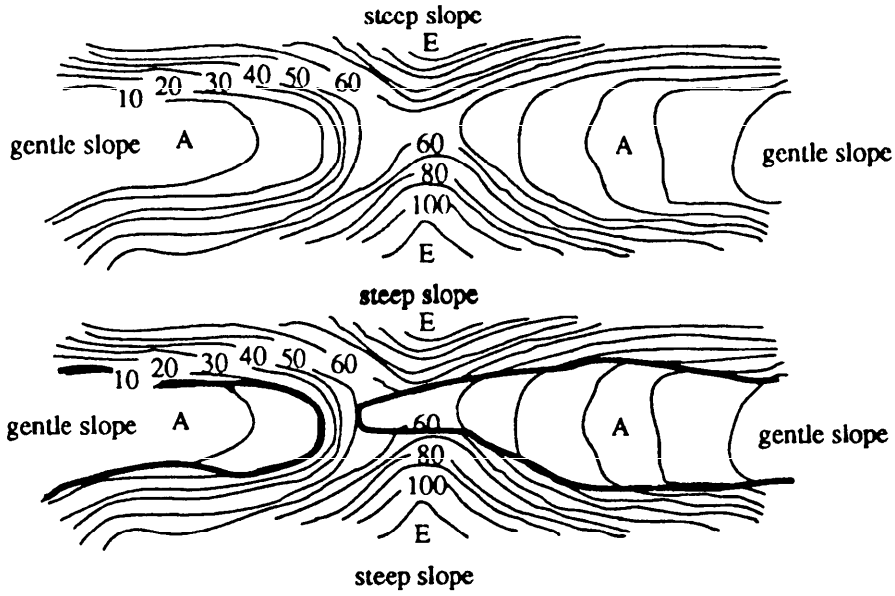


FIGURE 54. Depiction of a saddle/pass with a steep slope.

3.14.4 Areal extent.

a. Whereas surface configuration is represented by an areal overlay, all points within the neatline must be assigned a map unit code. The minimum size polygon shown shall have an areal extent of at least 20 square millimeters (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance).

b. Note that very steep (>60%), long (>5mm map or 250m ground distance), narrow or thin (<1mm map or 50m ground distance) slopes should be shown as escarpments (with teeth pointing down hill) on the Obstacles Overlay, as depicted in Figure 55.

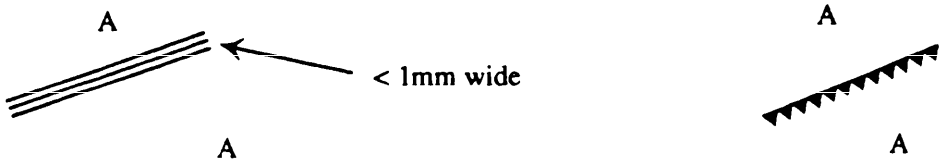


FIGURE 55. Depiction of steep, long, thin slopes as escarpments on the Obstacles overlay.

3.15 Vegetation. This section provides the basic guidance for the production of the Vegetation Overlay for the TTADB.

3.15.1 General vegetation information.

a. Vegetation features shown include those which:

(1) Provide orientation
(2) Afford cover and concealment for troops, vehicles or unattended ground sensors.

(3) Present obstacles to cross-country movement.
(4) Serve as landmarks.
(5) Provide other significant land use information with military significance.

b. Vegetation legend categories are shown in Appendix D, pages 130 - 132.

3.15.2 Vegetation classification and coding.

3.15.2.1 Vegetation type.

3.15.2.1.1 Vegetation legend. Vegetation types are classified and coded with letters, or a combination of letters and numbers. A sample Vegetation Legend showing the classification scheme and map unit codes is given in Appendix D, page 130. The legend is tailored to each job and usually includes only those categories that appear on any of the overlays within the project area.

3.15.2.1.2 **Vegetation categories**. (Symbol 103, labeled "A1 to "X" as listed below). The categories reflect similarities in military significance and not taxonomy. The following is a glossary of vegetation types to be shown and map unit codes used to represent them on the overlays. The alphanumeric map unit codes are standardized and remain the same for all projects.

a. Agriculture (Cropland) - Soil tilled for the growing of crops is considered land under cultivation. Ground left fallow on a seasonal basis is included in this category. Orchards/plantations/nurseries and vineyards are considered as separate categories.

(1) **Dry Crops** (code A1): Crops grown in moist or dry conditions that are generally free of other vegetation (except near fencelines or hedgerows). Included in this category are crops such as grains, tubers, legumes and vegetables.

(2) **Wet Crops** (code A2): Crops grown in a wet environment, usually flooded in the spring and kept saturated until harvest time. Small dikes or walls often enclose the area, such as a rice paddy.

(3) **Terraced Crops** (code A3): Raised areas of cropland supported by embankments or retaining walls. These crops, wet or dry, are generally found in small mountain valleys and on hillsides world wide, forming a step-like effect and are culturally related.

(4) **Shifting Cultivation** (code A4): The predominant vegetation is removed (by cutting, burning, etc.) and crops are planted in its place. In 2 - 3 growing seasons the soil nutrients are exhausted, the field abandoned, and secondary succession begins. The result is a mixed patchwork of small crop fields and small stands of young trees of differing heights scattered throughout the region. Individual polygons of crops and young trees, which are smaller than the minimum size criteria, shall be combined into one polygon consisting of shifting cultivation, which is coded A4. This type of extensive swidden agriculture, often referred to as "slash and burn agriculture", generally follows a 15 to 20 year cycle. It is found worldwide, but usually only in tropical and subtropical regions.

b. Brushland/Scrub - Brushland consists of woody plants with more than one stem. Brushland includes heath, shrubs, thickets, and other low growing multi-

stemmed bushes. Scrub is usually vegetation dominated by shrubs and located in arid, semi-arid, or temperate areas. Scrub growth includes cactus, mesquite, sagebrush, chaparral, thickets, etc. This vegetation type is shown in two categories depending on the density of the plants. Dwarf trees less than five meters high at maturity, unless in orchards, will also be included in these areas.

(1) **Brushland/Scrub with open to medium spacing** (code B1): Areas where the plant density covers from 5 to 50 percent of the ground surface and is less than 5 meters high.

(2) **Brushland/Scrub with medium to dense spacing** (code B2): Areas where the plant density covers from 50 to 100 percent of the ground surface and is less than 5 meters high.

c. Forested Areas - This category has three divisions defined by the predominant tree type. A tree is defined as a perennial woody plant at least 5 meters in height at maturity, with a single stem and definite crown shape.

(1) **Evergreen/Coniferous Forest** (code C): More than 60 percent of the trees in the area retain their foliage throughout the year. In addition to evergreen/ coniferous trees, this category also includes broadleaf evergreen trees, such as Live Oak, Holly Oak, Cork Oak, and tropical broadleaf trees like Magnolia, Ebony, Mahogany, etc.

(2) **Deciduous Forest** (code D): More than 60 percent of the trees in the area lose their foliage seasonally. In addition to broadleaf deciduous trees, this category also includes deciduous conifers, such as Dawn, Redwood, and the Larch species.

(3) **Mixed Forest** (code E): Contains both evergreen/ coniferous and deciduous trees in proportions varying between 40 to 60 percent.

d. Commercially Treed Areas - These consist of areas of planned plantings of rows of evenly spaced perennial treed vegetation, generally free of underbrush and vines. These trees yield nuts, spices, fruits or other commercial products exclusive of timber. In some areas, general agriculture is carried on beneath and between the trees. A tree is defined as a perennial woody plant at least 5 meters in height at maturity, with a single stem and definite crown shape. Note that some orchards are now planted with dwarf trees, whereby a smaller mature height is maintained by a combination of pruning and root stock grafting which will stunt the trees' growth. This category has four divisions differentiated on the basis of leafing characteristics and habits, similar to the forested areas:

(1) **Evergreen/Coniferous Orchard/Plantation/Nursery** (code FC): More than 60 percent of the trees retain their foliage throughout the year. Both broadleaf and evergreen coniferous trees are included in this category.

(2) **Deciduous Orchard/Plantation/Nursery** (code FD): More than 60 percent of the trees in the area lose their foliage on a seasonal basis. This class includes both broadleaf and coniferous deciduous trees.

(3) **Mixed Orchard/Plantation/Nursery** (code FE): Contains both evergreen coniferous and deciduous trees in proportions varying between 40 to 60 percent.

(4) **Palm Orchard/Plantation/Nursery** (code FP): Plantings of normally evergreen trees with simple stems and a crown of large fan-shaped leaves found in tropical and subtropical climatic zones. Some of the better known products from these palm orchards, plantations, and nurseries include bananas, coconuts, oils, and dates.

e. Grasslands - Grasses include all kinds of non-woody plants.

(1) **Grassland, Pasture, Meadows** (code G1): A grassland is an extensive area of herbaceous plants consisting primarily of grass. In middle latitudes grasslands are often termed prairies (tall grass, greater than or equal to 1 meter) and steppe (short grass, less than 1 meter). Poorly drained grasslands are commonly called meadows.

(2) **Grassland with Scattered Trees** (code G2): Primarily a grassland with widely spaced, scattered trees (with a maximum canopy closure of 10 percent) and scrub growth intermixed throughout the area. An abandoned field reverting back to a forest, as well as a tropical savanna, would exemplify this category.

f. **Forest Clearing** (code H) - Areas where some or all of the forested vegetation has been removed by natural or man-made causes, such as logging areas and burns. Since vegetation or silviculture practices will quickly change these areas, this code should not be used if another code better describes the area.

g. Swamp - A low lying saturated area when compared to the regional topography, but it can exist on flat-lying areas created by certain geomorphic environments. Swamps are covered with shallow water all or most of the year, where accumulating vegetation does not rapidly decay. The swamp code will have a digit depicting canopy closure since swamps contain trees and/or shrubs whose roots are adapted to wet conditions. The most common swamps are mangrove, nipa or cypress. The swamp category (code I) is subdivided into the following four separate swamp vegetation classes:

(1) **Evergreen/Coniferous** (code IC): A swamp area where more than 60 percent of the trees retain their foliage throughout the year. Included in this class are nipa swamps, which consist of a dense growth of stemless palms found in tropical and semi-tropical tidal and brackish waters. It usually occurs farther inland than mangrove and forms strips in channels through which the tidal waters flow.

(2) **Deciduous** (code ID): A swamp area where more than 60 percent of the trees lose their leaves seasonally. Of the various types of deciduous swamps, the cypress swamp is the best known. It consists of large bald cypress trees (up to 30m high), mostly deciduous conifers, with buttressed trunks and vertical knees extending upward from submerged roots, and is mainly found in the southern U.S.

(3) **Mixed** (code IE): A swamp area which contains both evergreen/coniferous and deciduous trees in proportions varying between 40 to 60 percent.

(4) **Mangrove** (code IM): A separate swamp class with a dense growth of trees with tangled aerial roots usually found along seacoasts and banks of tidewater streams in tropical and semi-tropical areas.

h. **Marsh/Bog** (code J) - A marsh is a wet or periodically inundated treeless region generally characterized by grasses or reeds. Both tidal and non-tidal areas are included in this category. A bog is a permanently wet area characterized by the growth of sphagnum (peatmoss) on an accumulation of organic matter. If numerous trees (greater than or equal to 5 percent canopy closure) are present, include bog in the swamp category.

i. **Wetlands** (code K) - Land subject to inundation

(1) Wetlands are areas which may be temporarily covered with non-tidally influenced water on a periodic basis. These fluctuating inundations may be related to daily , seasonal, annual, or longer responses due to natural or man-induced stresses or influences (i.e., reservoir control areas, salt evaporators, storm water runoff impoundments, storage ponds, etc., as well as areas subject to natural inundations as a result of periodic overflowing of a stream or body of water).

(2) Wetlands not categorized in the swamp, marsh/bog, or bare ground codes shall be placed in this category.

(3) Since the normal flood plains found alongside most streams are only inundated on an occasional basis by an extreme event (flood), they are not considered in this category.

(4) In regions with wet-dry (monsoonal) seasonal variations, the area between the normal, dry season, non-monsoonal, channel and any embankments built to hold the monsoonal floods (see Figure 56) shall be categorized as wetlands (land subject to inundation) on the Vegetation Overlay, provided some other vegetation code, such as wet crops (code A2 - usually rice paddies in monsoonal areas), marsh, swamp, bare ground, etc. does not better describe the vegetation situation in this area. The embankments are to be picked up on the Obstacles Overlay. In these regions, the following clarification note shall be added to the Vegetation Overlay legend:

NOTE: LSI by monsoonal flooding is normally dry during the non-monsoonal season.

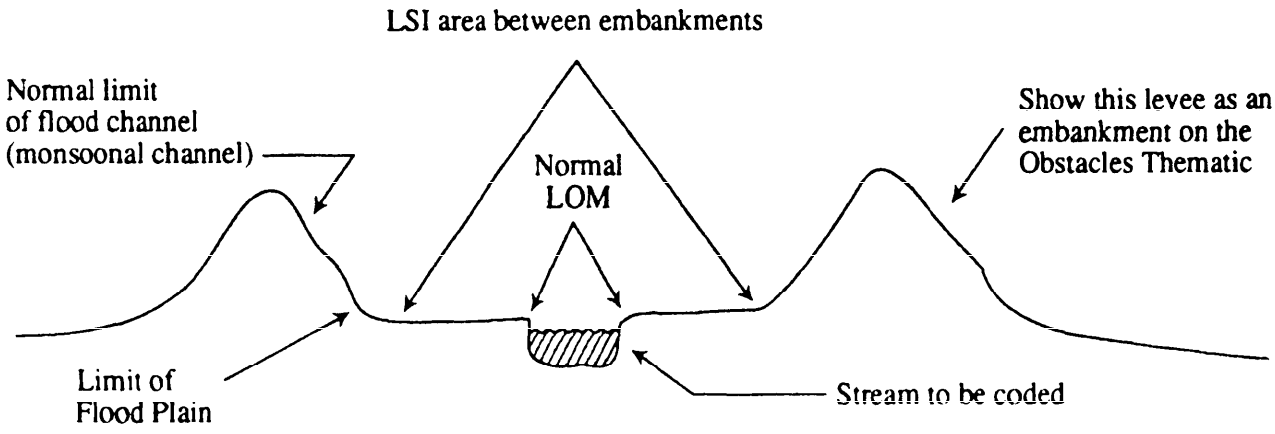


FIGURE 56. Monsoon area.

j. **Vineyards/Hops/Ginseng** (code L) - A vineyard is an area consisting of vines planted in a regularly spaced pattern, usually rows, generally 2 meters in height. Hops are a vinelike plant commonly found in Eurasia. Hops are planted in rows supported by poles and grow to heights of 3 to 4 meters. Ginseng is planted in areas that contain vertical protective structures up to 3 meters high. Also included in this category are tree nurseries with supported shading structures.

k. **Bamboo and Wild Cane** (code M) - A woody grass widely distributed in the tropics and subtropics with a height range of 3 to 30 meters and usually extremely dense. Sugar cane is also included in this category, in which case its name will appear in the descriptive title for code M within the Vegetation Legend.

l. **Bare Ground** (code N) - Permanently bare areas which contain little (less than 5 percent ground cover) or no vegetation, such as strip mines, sand dunes, beaches, lava flows, salt evaporators, bare mountainous areas, etc.

m. **Common Open Water** (code W) - Bodies of water, both natural and man-made, such as rivers, lakes, reservoirs, etc., as defined in 3.13.2. The delineations of these features are coincident with those on the Surface Drainage Overlay.

n. **Built-up Areas** (code X) - Man-made developments consisting of residential, commercial, industrial, and other areas, where the roads, paving, and buildings (roofs) cover approximately 30 percent or more of the available land area. Areas under construction, including subdivisions, if they meet the 30 percent criteria, shall be included in this category. Examples are villages, towns, cities, railroad yards, airports, etc. Developed areas with less than 30 percent built-up ground cover (such as suburban residential areas) will still allow cross-country movement and will not be shown on this thematic overlay. Built-up areas are often referred to as urban areas and, for terrain analysis purposes, they are treated as being the same.

(1) Built-up areas are normally symbolized by using straight lines. However, it is acceptable to outline built-up areas with curved lines, if the boundary follows the edge of some rounded feature, such as open water, a river, a railroad, a canal, or town wall.

(2) The built-up areas on this overlay are common to and shall also be depicted as Not-evaluated (Code X) areas on the Surface Materials (Soils) Overlay. Thus, they will be depicted with identical outlines on both overlays.

3.15.2.2 Canopy closure.

a. Canopy closure is defined as the percentage (%) of the ground area covered by the tree crown area. Crown area is the area covered by the vertical projection of a tree crown to the horizontal plane. Canopy closure is normally computed only for the forested (C, D, E), orchard/plantation nursery (FC, FD, FE, and FP), and swamp (IC, ID, IE, and IM) areas. Canopy closure is normally classified into the following four categories (See Appendix D, page 131):

Map Unit Code	Canopy Closure Category (%)
1	0 - 25
2	25 - 50

3	>50 - 75
4	>75 - 100

b. Canopy closure is given as the first numerical digit behind the C, D, E, FC, FD, FE, FP, IC, ID, IE, and IM codes.

c. Unless specified otherwise, canopy closure for all the other codes is assumed to be in the 0 to 25 percent category, except as listed below, and is not shown on the Vegetation Overlay. These categories may be overridden by information from the collateral sources or aerial photography.

Vegetation Category	Defined Canopy Closure (% Summer)
A4	>50 - 75
M	>75 - 100
X	>25 - 50

d. Note that winter canopy closure is directly derivable from summer canopy closure, but not vice versa. As the TTADB is usually produced for the optimal climatic season for military operations, summer canopy closure is given directly on the overlay. For winter canopy closure, the Concealment-Aerial Detection Table (See Appendix H) is used to determine the conversions from summer to winter canopy closure. If winter is optimal and winter canopy closure is given on the overlay, this table will not in all cases yield the correct winter to summer conversions.

3.15.2.3 Height.

a. Height ranges for the Forested (codes C, D, and E) and Orchard/Plantation/Nursery (codes FC, FD, FE, and FP) areas are given in meters and are usually divided into 9 categories as shown in Appendix D, page 131.

b. Height is given as the second numerical digit behind the vegetation type code.

c. Unless given individually, the height of the Brushland/Scrub (codes B1 and B2), Vineyards/Hops/Ginseng (code L), Bamboo and Wild Cane (code M) are defined to be in the 2 to 5 meter category. All other vegetation codes, except the treed agricultural area (code A4 - will have blocks of different aged and heighted trees) and Swamps (codes IC, ID, IE, and IM - heights can vary considerably) are defined to be in the 0 to 2 meter height category.

d. If needed, height values may be used for any vegetation type, i.e., tall grasses, bamboo and wild cane, vineyards/hops/ginseng, agricultural areas (open or treed), etc. For mixed vegetation types, such as the treed agricultural types, the predominant height of the tallest vegetation species (most often trees) shall be given. If a height code is assigned, a canopy closure code (either computed or default) must also be used as the first numerical digit following the vegetation type code.

3.15.2.4 Undergrowth.

a. Undergrowth is defined as the vegetation layer beneath the forest canopy and above the forest floor. This layer normally consists of small woody and herbaceous plants, generally less than 5 meters in height. Undergrowth is

a major factor in determining intervisibility and mobility within wooded areas, and they can be either the same or quite different from summer to winter. Only the summer undergrowth condition is shown on the Vegetation Overlay.

b. The presence and density of undergrowth is given in two categories. This information is generally collected in the field or from collateral sources:

(1) A solid line under a forest vegetation map unit indicates dense undergrowth (greater than 50% ground coverage).

(2) No underline indicates sparse to medium (0 to 50 percent ground coverage) undergrowth, no undergrowth, or the presence and/or density of undergrowth is unknown.

c. The undergrowth underline symbol will be a straight line version of symbol 104 (_____).

3.15.2.5 Vegetation roughness factor (VRF).

a. The vegetation roughness factor (VRF) is an estimated numerical factor reflecting the degree of degradation of vehicular speed solely due to travel through a particular type of vegetation, as though it is on horizontal ground. The VRF allows input to the synthesized models, such as the CCM model, for psychological and physical vegetation terrain characteristics which are not directly captured in the data base, but which will cause a human or mechanical slowing of vehicles and/or foot troops. These include factors which interfere with visibility or actual movement such as tall grasses or crops, fallen trees, tree stumps, low hanging and/or dense branches, thick vines, plowed fields, root emergence, etc. Note that stem diameter and tree spacing are treated as inputs to all known CCM models and thus are not considered in estimating the VRF.

b. The factors designated are subjective and determined by a group of experienced vegetation analysts (best if made by analysts knowledgeable about, experienced on, and/or trained in the ride dynamics and performance characteristics of military vehicle movement) for the entire project area. In general the VRF's are generic and applied equally to all vehicles. However, if needed, the VRF's can be tailored for individual vehicles or vehicle types (such as tracked, wheeled, or foot troops). In estimating the magnitude of the factors for specific vehicles or vehicle types, the analysts consider not only all of the physical characteristics of the vegetation types but also the physical characteristics of the vehicles, such as vertical obstacle climbability, ground clearances, sight height of vehicle driver, wheel sizes, as well as the usual lengths, widths, heights, etc.

c. The factors can be any numeric value from 0.00 to 1.00 in 0.05 increments. These factors are multipliers in the vegetation module of the CCM model. The factor decreases with increasing difficulty of movement. For example, a vegetation roughness factor of 0.80 would degrade the computed vehicle speed by twenty percent. Thus, a vegetation roughness factor of 1.00 for a vehicle class would indicate no degradation in the appropriate season. Bare ground is an example of an area with a VRF of 1.00. Most grasslands, meadows, pastures, and agricultural areas with little effect will have VRF's of 0.90 to 0.80 depending on the predominate vegetation for the season. However, a virtually impassable mangrove swamp with a tangle of aerial roots would have VRF's of 0.10 to 0.00. The final set of VRF's should reflect a logical degree of difference in the relative difficulty of movement

through the vegetation in one area as compared to movement through the vegetation another area, disregarding stem diameter and tree spacing.

d. Each vegetation type is given a VRF. These reflect the vegetation influence on movement on a normal dry day, usually during the summer (VRFS). Note that a low VRF can be caused by mechanical factors (fallen timber, stumps, etc.) as well as human factors (visibility affected by low hanging branches, leafy undergrowth, bushes, etc.).

e. The VRF's for vegetation areas without tree heights (including the treed agricultural and swamp areas) are listed separately, as shown in Appendix D, page 131. This is an example only; the table must be tailored for each project area. The estimated VRF's for the vegetation areas with tree heights are categorized in the Tree Spacing/Stem Diameter/Vegetation Roughness Table, as shown in Appendix D, page 132.

f. A table of the typical range of VRF's for tracked vehicles with possible causes of variation is given in Appendix E, page 145.

g. The vegetation roughness factor values listed in the Appendixes are examples only and will be adjusted to reflect actual conditions in the project area. Once determined by the analyst they must remain the same throughout the project area. **The vegetation roughness factors apply only to the vegetation effect on human and mechanical factors and not related factors such as slope or soils.**

3.15.2.6 Tree spacing/stem diameter/vegetation roughness table.

a. Tree spacing, stem diameter, and vegetation roughness factors for the vegetation areas with tree heights are listed in a table. The purpose of this table is to supply vegetation data needed for the generation of cross-country movement and other synthesized products. This table is a separate part of the Vegetation Legend, Appendix D, page 132. An example is provided at the bottom of the table to aid in reading it.

b. Stem diameter is the diameter of a tree trunk at approximately 1.5 m or 4.5 feet on the high side (if on a hillside) above the surface of the ground (commonly referred to in most forest literature as the diameter at the breast height or dbh). For trees in height category 1 (0 to 2 meters high) the stem diameter should be measured at their mid-point between the ground and stem tip. Stem diameters are derived from collateral sources or from equations based on crown diameter and/or tree height, or, if available, from actual field measurements. In these specifications, stem diameter is the average diameter in centimeters of the trees within a coded area.

c. Tree spacing is the distance from the center of one tree to the center of the nearest adjacent tree. In these specifications, tree spacing is the average distance in meters between the centers of the trees within a coded area.

d. The Tree Spacing/Stem Diameter/Vegetation Roughness Table may be provided in any of the places listed below in order of preference:

(1) As part of the legend on the Vegetation Overlay.

(2) If space is available in a large single polygon (usually large common open water areas (which are coded W on this thematic overlay), the table can be placed directly on the Vegetation Overlay. No part of the table may be positioned across the neatline.

(3) As a separate overlay if required by space limitations.

3.15.2.7 Miscellaneous vegetation features.

a. Additional vegetation features may be encountered which are of landmark significance to military operations. In some geographic settings, features such as isolated trees, small clumps of trees, golf courses, cemeteries, etc., may be of significance. Depiction of these or other similar features may require modification of the legend and/or symbology in order to provide unique symbology for the feature. Where possible, standard (as defined in this specification) letter or letter/number vegetation polygon identification codes will be used. If the feature requires unique symbology, standard symbols from the Military Specifications for 1:50,000 Scale Topographic Maps of Foreign Areas (MIL-T-89301) will be used to the maximum extent possible.

b. Tropical rainforests present a unique situation due to multiple canopy levels. The number of canopy levels can be represented by Roman Numerals I, II, or III corresponding to one, two, or three levels. These numbers will follow the height code, such as D47II, C36I, E49III, etc. On the ground the crown cover of the multiple canopies is usually thick enough to fit into the 75 to 100 percent crown closure category. The height code represents the highest canopy. The "type" category is generally mixed or coniferous/evergreen forest, since many of the trees are broadleaf evergreen species, i.e., mahogany, ebony, etc. In areas of thin jungle vegetation, canopy closure percentages are incorporated or combined together, as necessary.

c. Appendix I gives the definitions and specifications for previously used and requested miscellaneous features, including tundra (three types), treed agricultural areas (two additional types), ditch irrigation, and nipa swamps.

d. For areas that contain a variety of vegetation categories which are below minimum size specifications, the recommended procedure is to group the area into the most restrictive category (i.e., most conservative in terms of movement and concealment).

3.15.3 Areal extent.

a. Whereas vegetation is represented by an areal overlay, all points within the neatline must be assigned a map unit code. The minimum size polygon shown will have an areal extent of at least 20 square millimeters (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance).

b. Exceptions are made in areas containing sparse vegetation. In such cases, small clumps or narrow strips of vegetation which provide concealment or orientation or serve as landmark features, like desert oasis, are shown. Long thin strips of vegetation (<1mm wide), depending on their regional importance would either be omitted or shown as per 3.15.2.7 above.

3.16 Demarcation.

This section is not applicable to this specification.

3.17 Aeronautical.

This section is not applicable to this specification.

3.18 Names and labeling.

a. On the TTADB thematic overlays, features are normally identified by symbols and not by name(s). In the rare case that a miscellaneous or unique feature should need to be named on a thematic overlay, the name should be taken from the base map to which the thematic overlay is keyed.

b. Where no name appears on the base map, refer to MIL-T-89301, as well as MIL-STD-600002 and MIL-STD-600004, for proper naming and labeling of applicable features.

c. The following is a list of features which may not appear in the symbology or legend appendixes, but may at some time need to be named on the final product. Definitions for the following features may be found in MIL-STD-600004.

Feature Name	Proper Name Example
Banks	Outer Banks
Basin	Great Basin
Bay	Chesapeake Bay
Beach	Virginia Beach
Bench	
Bend	
Bluff	
Bottom	
Break	
Butte	
Canyon	Grand Canyon
Cape	Cape of Good Hope
Channel	English Channel
City	New York City
Cliff	
Corner	Tyson's Corner
Cove	
Crossing	
Desert	Sahara Desert
Dispersed Village	
Dome	
Everglade	Florida Everglades
Falls	
Flat(s)	
Forest	
Gap	
Gorge	
Gulch	
Gulf	Gulf of Mexico

Gut	
Hamlet	
Harbor	Boston Harbor
Head	
Highland	
Hill	
Hole	
Hollow	
Inlet	Hamilton Inlet
Island Chain	Hawaiian Islands
Junction	
Jungle	
Knob	
Knoll	
Lagoon	
Lake	
Lands	
Lookout	
Marina	
Mesa	
Mountain	
Mountain Range	Rocky Mountains
Narrows	
Neck	
Ocean	Atlantic Ocean
Park	Yellowstone National Park
Pass	
Passage	
Patch	
Peak	Pikes Peak
Plain	Great Plains
Plateau	Colorado Plateau
Point	
Pool	
Port	
Range	Coastal Range
Ravine	
Region	
Ridge	
River	
Roadstead	
Rock	
Sands	
Scattered Village	Comunidades of South America, Strevsudlung of Europe
Sea	Caribbean Sea
Sea Mount	
Shelf	
Shoals	
Sink	
Sound	Puget Sound
Spit	
Spring	
Spur	

Strait	
Summit	
Town	
Valley	Death Valley
Village	Greenwich Village
Wood	

d. Names on TTADBs shall be those approved by the U.S. Board of Geographic Names. Normally, U.S. maps of similar scale serve as a guide to features to be named. Individual features of a group are not labeled, instead the names of groups of features are shown (e.g., archipelago, mountain range, etc.).

3.19 Radar.

This section is not applicable to this specification.

3.20 Annotation.

This section is not applicable to this specification.

3.21 Special area.

This section is not applicable to this specification.

3.22 Symbology and type on the final thematic overlays. Symbology for the TTADB Overlays is shown in Appendix B. Examples of legends and tables are shown in Appendix D. Refer to the applicable section 3 paragraphs of this specification for placement rules and inclusion conditions for the various TTADB thematic overlays.

3.22.1 Symbology.

3.22.1.1 Symbols, lines, arrows and codes.

a. Symbols, lines, arrows and codes should not overlap or touch other codes, lines, arrows or symbols. An exception to this rule is made for data information holders and offset symbols which have a leader line extending from them toward their location or located symbol on the map sheet (i.e., bridges, dams, locks, etc.). For examples, see illustrations in Symbology Appendix (Appendix B).

b. Where cartographically possible, the minimum clearance between the codes, symbols, and linework of different features is 1.0mm (0.04 inches).

c. Leader lines (Symbol 100), arrowheads (Symbol 101) and point of change symbols (Symbol 102) shall end at their associated feature symbol or linework location with a gap of 0.25mm (0.01 inches).

d. Symbols and codes should not be broken to fit around other symbols, codes or linework.

3.22.1.2 Point of change symbol. Point of change (POC) markers (Symbol 102) indicate non-intersection locations where the characteristic of a linear or areal feature changes or to mark the position of multiple linear features in the

same line segment. Point of change markers are not needed where one linear feature abuts another (the symbology change indicates the point of change) or at the intersection of linear features. Each segment will be individually identified.

3.22.1.3 Leader Lines.

3.22.1.3.1 Lineweight of leader lines. In order to differentiate leader lines from the standard linework and symbols, leader lines have a lineweight of 0.20mm (0.008 inches), whereas the standard linework and symbol lineweight is 0.30mm (0.012 inches).

3.22.1.3.2 Positioning and length of leader lines. Leader lines (Symbol 100) shall start 1.0mm (0.04 inches) from codes, letters and/or numbers. Leader lines shall have a minimum length of 2.0mm (0.08 inches) and a nominal maximum length 40.0mm (1.6 inches). Leader lines should be as short and direct as possible while still maintaining minimum lengths, legibility, and preferred positioning of symbols and type.

3.22.1.3.3 Breaking leader lines. Leader lines, if possible, should not be broken. However, if necessary, leader lines may be broken, with a gap of 0.5mm (0.02 inches) on each side of the break, no more than twice (once is preferred), because of the density of detail and lack of room for placement.

3.22.1.3.4 Number of leader lines from one code or symbol. Each code, symbol, or data information holder should have only one leader line extending from it. However, to improve legibility and clarity in very dense areas, codes, symbols and data information holders may be grouped together with multiple leader lines pointing to the individual feature or symbol locations. In addition, the leader line leaving the code, symbol or data information holder may be shared, if necessary for clarity and legibility. However, shared leader lines must diverge from each other before reaching their individual feature, symbol location or arrowhead.

3.22.1.3.5 Leader lines turning corners. Leader lines will make turns (change direction) with straight line (point to point) angles rather than curves, to avoid confusion with curved features.

3.22.1.3.6 Leader lines without arrowheads. In general, leader lines without arrowheads indicate point features (features with a longitudinal axis of less than 2.0mm (0.08 inches).

3.22.1.3.7 Leader lines with arrowheads. Leader lines with arrowheads indicate linear or areal features. The leader line is centered on the arrowhead so the shaft comes out of the back of the arrowhead in line with the arrow point. Arrowhead lengths are not included in the overall minimum length requirements for the leader line.

3.22.2 Type.

3.22.2.1 Type style and size.

a. Type Style - Unless designated otherwise under the appropriate symbol in Appendix B, the type used for identifying or coding features on the final overlays is Univers Medium (113A) style for type sizes 24 point or smaller and Univers Light (114A) style for type sizes larger than 24 point. If Univers style type is not

available, a closely matching style may be substituted. All type numbers in parentheses are DMA type number references only.

b. Type Size - Where the type specifications permit a range of type sizes based on the areal limits of a feature, a Type Template (as shown in Appendix G) is used as a guide to assure uniformity of selections. When space prohibits the use of a prescribed size, or the size indicated by the template will obviously distort the relative importance of the feature a more appropriate size is to be selected.

c. Type sizes and styles for attribute values in data information holders and symbols are provided in Appendix B.

d. If lettering is inked, it should approximate the Univers type in size and style. A sampling of various Univers type sizes and styles is provided in Appendix F.

3.22.2.2 Descriptive type.

a. Descriptive type is used to provide information about the identification of features or conditions that cannot be fully portrayed by map symbols. It can be simply a label used to identify a symbol, or it can be used to label or describe an area or a particular feature. It can also be used for notes of caution or may, as circumstances dictate, detail an important or peculiar aspect or activity of an area.

b. The type style for terrain analysis descriptive type is Univers Medium (113A). If the type describes an area, group of features, or a unique situation then all the type is in lower case. If the type describes a point or linear feature the type is also all in lower case. For example: minefields or impact area (area features), falls (point feature), and pipeline (linear feature). Type size is limited to 7 pt, 8 pt, and 10 pt. Type size used should be consistent with the type size used throughout the sheet.

c. Conditions can exist where descriptive type would be applicable throughout a sheet. Consideration should be given to adding a note to the margin as opposed to placing type throughout the sheet. For example: "CAUTION: Roads subject to coverage by drifting sand".

3.22.2.3 Positioning type.

a. Letters and/or number codes are centrally positioned within an areal feature, where possible. When the feature is too small to accommodate a code, the code should be positioned adjacent to the feature with an arrowheaded leader line pointing to the area. Codes or arrows should not touch any other code, line or symbol. All letters and/or numbers should read from left to right and be oriented parallel to the tangent of the south neatline of the base map, except for coding on certain linear features where codes are oriented along or parallel to the feature. The size of the code used may vary according to the size of the area. A large open area, for example, will be coded with a larger letter and/or number placed within it than a smaller open area. (See Figure 57 and 3.22.2.1.b.).

b. If a proper horizontal position for a code can not be found within the nominal maximum 40mm (1.6 inches) distance for the leader line, then the code

may be tilted to fit between features provided minimum clearances and all of the required distance specifications are met. Tilting should be done so that the code reads left to right or bottom to top, if vertical. Off-set symbols and data information holders are not tilted.

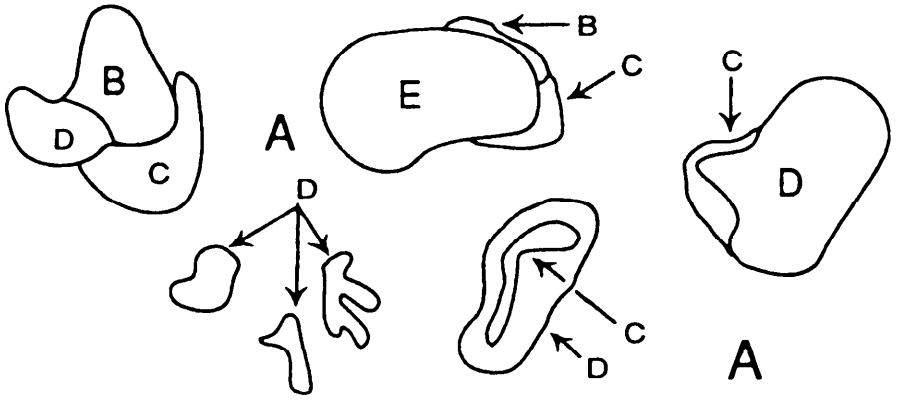


FIGURE 57. Placement of codes on areal features.

c. If a proper position for a code is still not found after attempting to tilt it, then the closest horizontal position beyond the 40mm (1.6 inches) maximum may be utilized.

d. Normally, codes, arrows, leader lines and symbols shall not be depicted within the open water areas except for the "W" code. Exceptions may be necessary when the surrounding area is extremely dense and the only available space for the placement of codes and/or symbols is within the open water area. If coding is placed within the open water area, the entire code and/or symbol must be placed within the open water area, not partially in the open water and partially on land.

3.23 Reproduction and storage. The inked or engraved overlays in final format will be reproduced and stored by DMA as film negative reproduction material. The film negative material can then be used to produce transparent overlay copies.

3.24 Feature/Attribute. Refer to the applicable paragraphs in section 3, as well as Appendix B, Symbology; Appendix D, Legends; and Appendix I, Miscellaneous Features, for the features, feature attribute values, inclusion conditions, and specific rules corresponding to TTADB production of the various thematic overlays.

3.25 Magnetic variation.

This section is not applicable to this specification.

3.26 Surface materials. This section provides the basic guidance for the production of the Surface Materials Overlay for the TTADB.

3.26.1 General surface materials information.

a. The treatment of surface materials is limited to those parameters of soils and other surface materials identified as significant to existing and anticipated data requirements for tactical military operations.

b. Surface materials are classified and coded with two letters designating surface material type followed by one or two numbers designating surface roughness type. Whereas the two letters designating surface material type remain the same for all projects, the latter numerical sets are reordered and tailored for each project area. Areas that are not evaluated (generally built-up areas) and common open water areas are identified with the single letters "X" and "W", respectively. Soil depth is indicated by underlining the code with a solid line, and moisture content is shown by underlining the code with a sequence of dashes or dots.

c. A sample legend showing soil type and surface roughness codes (map units), and all other information to be shown on the Surface Materials Overlay is provided in Appendix D, pages 133 - 135.

3.26.2 Surface material classification and coding.

3.26.2.1 Surface materials definitions.

a. Surface materials, as defined for this thematic overlay, consist of soils and a number of other materials including rock outcrops, permanent snowfields, and evaporites. Surface materials are analyzed and mapped from the ground surface to a depth of 50cm, with particular emphasis on the depth between 15 to 38cm (6 to 15 inches) below the surface. This is generally the critical layer for cross-country movement, where the rating cone index (an indicator of the soil load bearing capacity) is considered the most significant measure of trafficability.

b. For the purposes of terrain intelligence, soil is defined as the unconsolidated material that overlies bedrock. All soils are classified according to the Unified Soil Classification System (USCS). The information given in the following section was derived mainly from "The Unified Soil Classification System," Corps of Engineers, U.S. Army, Technical Memorandum No. 3-357, Vols. 1 and 3, March 1953 (Revised April 1960).

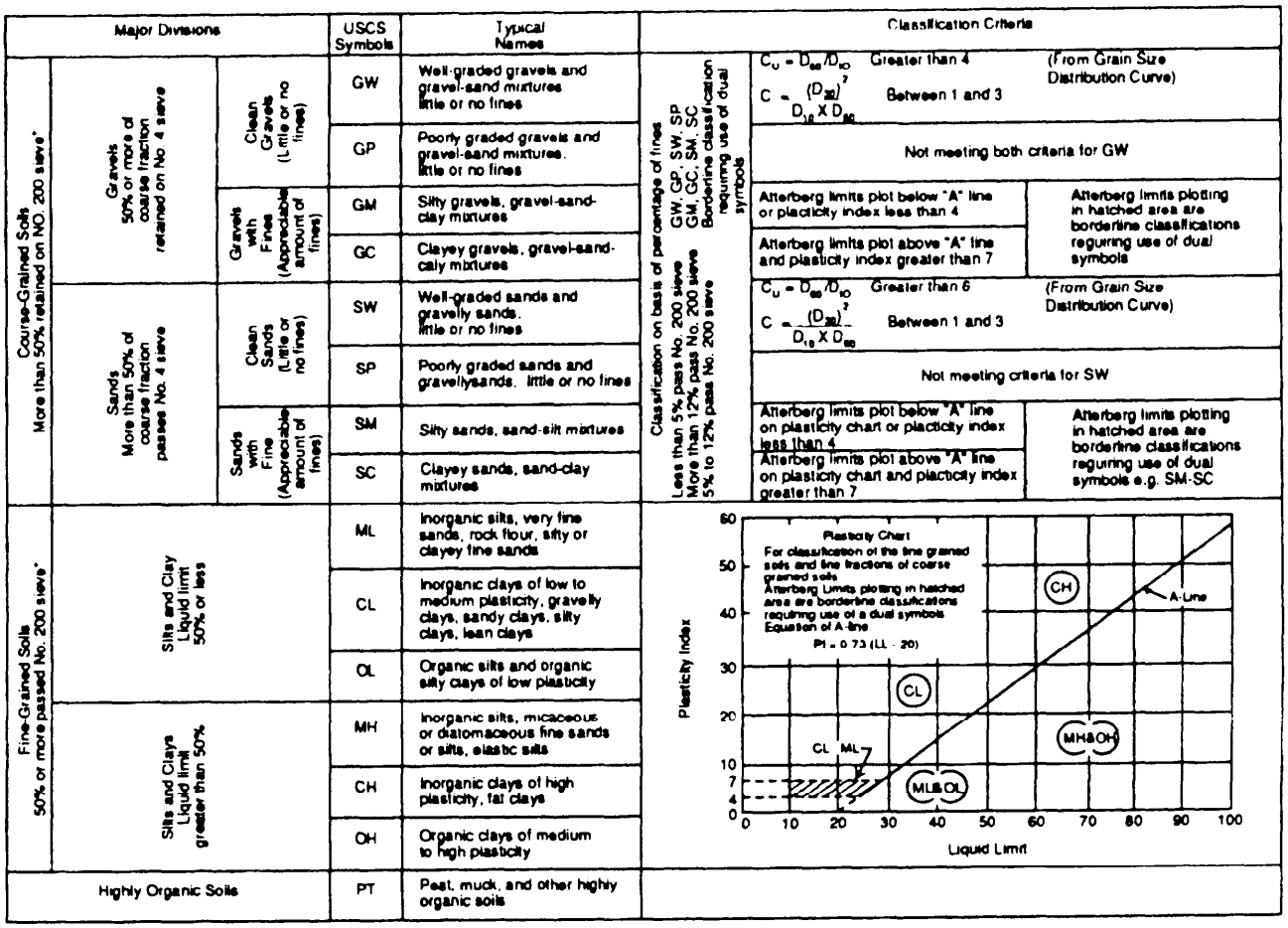
3.26.2.2 The Unified Soil Classification System.

3.26.2.2.1 General.

a. The Unified Soil Classification System (USCS) was designed to classify soils in accordance with the properties they possess which influence their behavior as a construction material for roads, airfields, embankments, foundations and other engineering structures. The U.S. Army has adopted the USCS for use not only for the aforementioned purposes but also to indicate soil trafficability characteristics for cross-country movement evaluations and to designate areas suitable for foxhole and/or mortar pit excavations and sensor emplacement.

b. The USCS categorizes all soil particles up to 7.62cm (3in) in diameter into three major divisions: coarse-grained soils, fine-grained soils, and highly organic soils. A summary of the USCS can be found in Figure 58. This classification system does not consider coarse fractions greater than 7.62cm (3in) in diameter.

(1) Coarse-grained Soils.



*Based on the material passing the 3-in. (75mm) sieve

Where: C = Coefficient of Curvature

C_U = Uniformity Coefficient

D_{10} = Grain diameter in mm at which 10% of material by weight passes sieves

D_{30} = Grain diameter in mm at which 30% of material by weight passes sieves

D_{60} = Grain diameter in mm at which 60% of material by weight passes sieves

FIGURE 58. Unified Soil Classification System.

(a) Coarse-grained soils are identified and classified by sieve analysis. They contain greater than or equal to 50 percent, by weight, soil material that is retained on a No. 200 sieve. This sieve has an opening size of 0.074mm (approximately equal to the smallest size particle visible to the naked eye).

(b) Coarse-grained soils are subdivided into gravels and sands. The gravels are characterized as having greater than half of the coarse fraction (soil material retained on the No. 200 sieve) larger than the No. 4 sieve size (4.76 mm); whereas sands are characterized as having greater than half of the coarse fraction smaller than the No. 4 sieve (4.76mm). Coarse-grained gravels and sands are further subdivided based on grain size distribution characteristics.

(c) The GW, GP, SW, and SP soil type groups (defined in 3.26.2.2.4) are made up of granular soil materials containing less than five percent fines (by weight) passing the No. 200 sieve (0.074mm).

(d) The GM, SM, GC, and SC soil type groups are composed of granular soil materials containing more than 12 percent fines (by weight) passing the No. 200 sieve (0.074mm).

(e) Gravels and sands containing between five and twelve percent fines (by weight) passing the No. 200 sieve are classified as borderline soils, which have characteristics of more than one soil type group. Borderline soils will be classified into the more restrictive soil type of the two comprising a particular borderline soil.

(2) Fine-grained Soils.

(a) Fine-grained soils contain greater than or equal to 50 percent, by weight, soil material that passes through a No. 200 sieve (0.074mm).

(b) Unlike coarse-grained soils, which are subdivided on the basis of grain size distribution, fine-grained soils are subdivided on the basis of compressibility and plasticity characteristics. Silts are defined as fine-grained soils which have plasticity indexes and liquid limits that plot below the "A" line (see plasticity chart) in Figure 58, whereas clays are fine-grained soils which have plasticity indexes and liquid limits that plot above the "A" line. Organic clays are an exception to this rule; they plot below the "A" line. Fine-grained soils are further subdivided based on liquid limits: low plasticity groups have liquid limits less than or equal to 50; and high plasticity groups exhibit liquid limits greater than 50.

(3) Highly Organic Soils - The highly organic soils, such as peat or muck, are readily identified by their distinctive color or odor, spongy feel, and their frequently fibrous characteristics; thus, no laboratory tests have been developed for their identification. They are classified into a single category and are not subdivided. When clay is present, organic soils generally have an organic carbon content ranging from greater than 12 to 18 percent (the latter when soil content is 60 percent clay).

3.26.2.2.2 Soil size fractions.

a. According to the USCS, soil particles are divided into four soil size fractions: cobbles, gravels, sands, and fines. Following is a listing of the size ranges for these soil material components:

Soil Fraction	Size Range
Cobbles	Larger than 7.62cm (3in)
Gravel	7.62cm (3in) to No. 4 sieve (4.76mm)
coarse gravel	7.62cm (3in) to 3/4in (1.91cm)
fine gravel	1.91cm (3/4in) to No. 4 sieve (4.76mm)
Sand	No. 4 sieve (4.76mm) to No. 200 sieve (0.074mm)
coarse sand	No. 4 sieve (4.76mm) to No. 10 sieve (2.0mm)
medium sand	No. 10 sieve (2.0mm) to No. 40 sieve (0.42mm)
fine sand	No. 40 sieve (0.42mm) to No. 200 sieve (0.074mm)
Fines (silt, clay)	Less than No. 200 sieve (0.074mm)

b. Fines (clay, silt, or both) are not subdivided in terms of particle size; rather, they are defined in terms of their plasticity and compressibility characteristics. "Silt" is used to connote fine-textured material exhibiting low plasticity; whereas "clay" is used to connote fine-textured material showing high plasticity characteristics.

(1) A plasticity chart is used in the classification of fine-grained material; this chart is shown in Figure 58. Laboratory test values are determined for the liquid and plastic limits of the portion of the soil material smaller than the No. 40 sieve (0.042mm) and the plasticity index is calculated. The plasticity index is then plotted against the liquid limit and entered into Figure 58, and the appropriate soil group classification is then assigned to the soil material. The "A" line in Figure 58 separates the plastic, clayey soil materials which are plotted above the line from the generally silty, non-plastic soil materials that are plotted below the "A" line.

(2) In the above discussion, the terms used to describe soil consistency have the following meanings:

(a) Liquid Limit (LL) - The percent moisture content (by weight) corresponding to an arbitrarily defined boundary between the semi-liquid and plastic states. The liquid limit line of 50 divides these soils into groups of high (H) or low (L) liquid limit and related plasticity.

(b) Plastic Limit (PL) - The percent water content (by weight) corresponding to an arbitrarily defined boundary between the plastic and semi-solid states.

(c) Plasticity Index (PI) - The moisture content (by weight) between a soil material's liquid limit and plastic limit (PI=LL-PL). The larger the PI, the more plastic the soil.

(d) Procedures for determining the LL, PL, and PI of a soil material are outlined in Technical Manual TM 5-530, Materials Testing, Departments of the Army, the Navy, and the Air Force, February, 1971.

3.26.2.2.3 Soil groups.

a. The soil groups in the USCS are composed of two letter (or four letters in the case of a borderline soil) connotative symbols composed of a prefix and a suffix. The prefix indicates the main soil type and the suffix indicates subdivisions of these main groups. A tabular listing of these symbol components follow:

Main Soil Type	Symbol
Gravel	G
Sand	S
Silt	M
Clay	C
Organic silts and clays	O
Peat	Pt

Gradation	
Well-graded	W
Poorly-graded	P
Liquid Limit	
Low LL (< 50)	L
High LL (>= 50)	H

b. The terms used under the heading of "Gradation" above have the following definitions:

(1) Well-graded - soil materials characterized by a complete range of all representative grain sizes, and without an excess or deficiency of any of these grain sizes.

(2) Poorly-graded - soil materials characterized by predominantly one grain size (these materials are commonly described as uniformly graded) or a range of sizes with some intermediate sizes missing (these materials are sometimes described as gap-graded, skip-graded, or step-graded).

3.26.2.2.4 **Soil categories**. (Symbol 103, labeled "GW" to "PT" as listed below). The following is a description of each individual USCS soil type group to be shown and the standard USCS soil designator used to represent them on the Surface Materials Overlay. These soil type codes are standardized and remain the same for all projects:

a. **Well-graded gravels** (code GW) - Well-graded gravels are coarse-grained soils where more than 95 percent of the soil material by weight is larger than 0.074mm (No. 200 sieve). These soils are clean, well-graded gravels and gravel-sand mixtures where more than 50 percent the coarse fraction by weight is larger than 4.76mm (No. 4 sieve), and which contain little or no non-plastic fines. Any fine textured soil material present must not interfere with internal drainage or appreciably affect soil strength characteristics.

b. **Poorly-graded gravels** (code GP) - Poorly-graded gravels are coarse-grained soils where more than 95 percent of the soil material by weight is larger than 0.074mm (No. 200 sieve). These soils are clean, poorly-graded gravels or gravel-sand mixtures where more than 50 percent of the coarse fraction by weight is larger than 4.74mm (No. 4 sieve), and which contain little or no fines. These soil materials are sometimes referred to as uniform gravels, which consist of predominantly one particle size; or gap-graded gravels and sands consisting of non-uniform mixtures of coarse material and fine sands, with some intermediate sizes missing and with little or no fines.

c. **Silty gravels** (code GM) - Silty gravels are coarse-grained soils where more than 50 percent of the soil material by weight is larger than 0.074mm (No. 200 sieve), and more than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve) in size. These predominantly gravel mixtures of soil material consist of more than 12% fines that are non-plastic or of low plasticity. The gradation of the soil separates in this soil group is not considered significant; thus, both well-graded mixtures of gravel-sand-silt and poorly-graded mixtures of silty gravel are included in this group.

d. **Clayey gravels** (code GC) - Clayey gravels are coarse-grained soils where more than 50 percent of the soil material by weight is larger than 0.074mm (No. 200 sieve), and more than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve). These predominantly gravel mixtures contain more than 12% clayey fines smaller than 0.074mm (No. 200 sieve) and exhibit low to high plasticity characteristics. This soil group includes well-graded mixtures of gravel-sand-clay and poorly-graded mixtures of clayey gravels.

e. **Well-graded sands** (code SW) - Well-graded sands are coarse-grained soils where more than 95 percent of the soil material by weight is larger than 0.074mm (No. 200 sieve) and less than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve). These soils are clean, well-graded sands and well-graded gravel-sand mixtures that contain little or no fines. Any fine-textured soil material present must not appreciably affect soil strength characteristics or interfere with internal drainage.

f. **Poorly-graded sands** (code SP) - Poorly-graded sands are coarse-grained soils where more than 95 percent of the soil material is larger than 0.074mm (No. 200 sieve), and less than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve). These soils are clean, poorly-graded sands and poorly-graded gravel-sand mixtures with little or no fines. They are sometimes referred to as uniform sands, which consist of predominantly one sand size; or gap-graded materials consisting of non-uniform mixtures of coarse material and fine sands with some intermediate sizes missing. Any fine textured soil material present must not appreciably affect soil strength characteristics or interfere with internal drainage.

g. **Silty sands** (code SM) - Silty sands are coarse-grained soils where more than 50 percent of the soil material is larger than 0.074mm (No. 200 sieve) and less than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve) in size. These predominantly sand mixtures of soil material consist of more than 12% fines that are non-plastic or of low plasticity. The gradation of the soil separates in this soil group is not considered significant; thus, both well-graded and poorly-graded mixtures of silty sands and sand-silt mixtures are included in this group.

h. **Clayey sands** (code SC) - Clayey sands are coarse-grained soils where more than 50 percent of the soil material is larger than 0.074mm (No. 200 sieve) and less than 50 percent of the coarse fraction by weight is larger than 4.76mm (No. 4 sieve). These predominantly sand mixtures contain more than 12% clayey fines smaller than 0.074mm (No. 200 sieve) and exhibit low to high plasticity characteristics. This soil group includes both well-graded and poorly-graded clayey sands and sand-clay mixtures.

i. **Inorganic silts and very fine sands** (code ML) - Inorganic silts and very fine sands are fine-grained soils where more than 50 percent the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit of less than or equal to 50; exhibit relatively low plasticity characteristics and lie below the "A" line on the plasticity chart (Figure 58); and include inorganic silts and very fine sands, rock flour, silty or clayey fine sands, and clayey silts with slight plasticity. Loess-type soils and kaolin clays exhibiting low plasticity characteristics usually fall into this class also.

j. **Inorganic silts** (code MH) - Inorganic silts are fine-grained soils where more than 50 percent of the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit of greater than 50 and lie below the "A" line on the plasticity chart (Figure 58), and exhibit low to medium plasticity characteristics. These soils include inorganic silts, micaceous or diatomaceous soils, fine sandy or silty soils, and elastic silts.

k. **Inorganic clays of low to medium plasticity** (code CL) - Inorganic clays of low to medium plasticity are fine-grained soils where more than 50 percent of the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit of less than or equal to 50; lie above the "A" line on the plasticity chart (Figure 58); exhibit low to medium plasticity characteristics; and include inorganic clays, gravelly clays, sandy clays, silty clays, and lean clays.

l. **Inorganic clays of high plasticity** (code CH) - Inorganic clays of high plasticity are fine-grained soils where more than 50 percent of the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit of greater than 50; lie above the "A" line on the plasticity chart (Figure 58); exhibit high plasticity characteristics; and include soil materials such as fat clays, gumbo clays, bentonite, and certain volcanic clays.

m. **Organic silts and organic silty clays of low plasticity** (code OL) - Organic silts and organic silty clays of low plasticity are fine-grained soils where more than 50 percent of the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit of less than or equal to 50; lie below the "A" line on the plasticity chart (Figure 58); exhibit low plasticity characteristics; and include organic silts and organic silty clays.

n. **Organic clays and silts of medium to high plasticity** (code OH) - Organic silts and organic silty clays of medium to high plasticity are fine-grained soils where more than 50 percent of the soil material is smaller than 0.074mm (No. 200 sieve). These soils have a liquid limit above 50 and lie below the "A" line on the plasticity chart (Figure 58).

o. **Peat and other highly organic soils** (code PT) - Peat and other highly organic soils are soils of a spongy, fibrous texture. Typical of soils in this group are peat, humus, muck, and some swamp and marsh soils. They are commonly composed of substantial amounts of leaves, grass, branches, or other fibrous vegetal matter in varying states of decomposition.

3.26.2.2.5 Supplemental surface materials. The USCS soils defined above are currently supplemented with the following additional surface materials, which are also normally shown in the legend:

a. **Rock Outcrop** (code RK) - Areas of bedrock with 10 percent or less soil cover present. The type of bedrock is not identified. Surface materials classified as RK (Rock Outcrop) shall not require underlining (paragraph 3.26.4) to indicate soil materials less than 0.5 meters deep; shallow soil is assumed.

b. **Permanent Snowfields** (code PS) - Areas covered by snow or ice throughout the year.

c. **Evaporites** (code EV) - Sediments deposited from aqueous solutions as a result of evaporation, such as salt pans, salt encrustations, areas of salt evaporators, etc.

3.26.2.2.6 Additional surface materials. Additional surface materials are almost certain to exist and when encountered will be given a two letter map unit code and added to the legend. Appendix I gives the definition and code for the only two previously requested surface materials features - rock fields and inorganic clay/silt combinations.

3.26.2.3 Altered surface materials and common open water.

3.26.2.3.1 **Not-evaluated areas** (code X).

a. The not-evaluated code is mostly used in areas where construction or development precludes evaluation of the natural surficial materials.

b. In common urban (built-up) areas, the surface materials are not determined due to their modification and alteration by man-made residential, commercial, and industrial developments where the roads, paving and buildings cover approximately 30 percent or more of the available land area, as defined in 3.15.2.1.2n., Vegetation. Examples are towns, cities, railroad yards, airports, etc. These features are obtained from the Vegetation Overlay.

c. The not-evaluated code may also be used in other areas of surface materials identified as being disturbed by man. Such areas will include extensive slag piles, mine tailings, land fills, garbage dumps, and other disturbed areas where the USCS coding would be inappropriate. In these instances, bracketed descriptive type will be used adjacent to or underneath the "X" to label the man-disturbed areas, e.g., X [Mine tailings].

3.26.2.3.2 **Common open water areas** (code W). These are bodies of water, both natural and man-made, such as rivers, lakes, reservoirs, oceans, etc., as defined in 3.13.2. All common open water areas will be obtained from the Surface Drainage Overlay. The open water map unit code "W" is standard for all thematic overlays.

3.26.3 Surface roughness classification and coding.

3.26.3.1 Surface roughness thematic subject. While surface roughness is a thematic subject in and of itself, it is included on the Surface Materials Overlay in order to save the need for another separate overlay and because it is most closely associated with surface materials and their weathering or erosional characteristics. Surface roughness is synonymous with microrelief and covers the expression of the land surface or surface geomorphic features which are less than the contour interval of the base map in height. For this thematic overlay, surface roughness is that aspect of the microrelief on the land surface (boulder fields, hummocky ground, gullies, rugged bedrock, etc.) which reduces the rate of cross-country movement for vehicles or foot troops during military operations.

3.26.3.2 Surface roughness numbers. Surface roughness is classified and coded on the Surface Materials Overlay by a project tailored set of sequential numbers designating the surface roughness type. Each separate surface roughness type found in the project area is assigned a number which follows the two letter

surface materials code. The only surface material types not assigned surface roughness type numbers are the not-evaluated (code X) and common open water (code W) areas. The surface roughness types are determined from stereoscopic photointerpretation, and the analysis of ground photos, written descriptions, field checks, and any other source providing the information.

3.26.3.3 Surface roughness descriptors.

a. In the surface roughness table, which is included as part of the Surface Materials Legend, each surface roughness type identified and coded on the project overlay(s) is given a corresponding surface roughness descriptor.

b. By design, the surface roughness descriptors are a generalized description of the small-scale differences in relief that are not normally shown or interpretable on a regular topographic map. Examples might include rock outcropping, boulders, patterned ground, solifluction lobes, coppice mounds or low sand dunes, and badland erosional features. These surface roughness descriptions can also include cultural features, for example, numerous closely spaced stone walls or closely spaced ditches, that can not be shown as discrete features yet in aggregate cause substantial degradation of the cross country movement rates for vehicles and foot troops. These descriptors shall detail the surface roughness within a specific mapping unit rather than combining several different and separately occurring surface roughness descriptions together.

c. Some examples of commonly used surface roughness descriptors can be found in Appendix D, page 135.

3.26.3.4 Surface roughness factors (SRF).

a. For each surface roughness type and descriptor in the legend, there is an associated set of five surface roughness factors (SRFs). Each SRF corresponds to one of the five categories of vehicle types or classes for which surface roughness is considered for the TTADB: Large and Medium Tanks, Small Tracked Vehicles, Large Wheeled Vehicles, Small Wheeled Vehicles, and Foot Troops.

b. These factors are estimated numerical values reflecting the degradation of the rate of vehicular and foot troop movement due to travel over a particular surface roughness type on horizontal ground. The SRF allows input to the synthesized models, such as the CCM model, for human factors and other physical surface roughness characteristics that are not directly captured in the data base, but which affect and influence the movement rate of vehicles and/or foot troops.

c. The factors designated are subjective and are determined by a group of experienced surface roughness analysts (best if made by analysts knowledgeable about, experienced on, and/or trained in the ride dynamics and characteristics of military vehicle movement) for the entire project area. In estimating the magnitude of the factors, the analysts consider not only all of the physical characteristics of the surface roughness types but also the physical characteristics of the vehicles, such as vertical obstacle climb heights, self-bridging capabilities, ground clearances, wheel sizes, and other vehicle parameters.

d. The factors can be any numeric value from 0.00 to 1.00 in 0.05 increments. In the CCM model these factors are used as multipliers. For example,

a 0.80 factor would degrade the computed vehicle speed by twenty percent. Similarly, a surface roughness factor of 1.00 for a vehicle class would indicate no degradation. Maximum vehicle or foot troop speed with a surface roughness factor (SRF) of 1.00 (no surface roughness effect) would occur on a smooth, hard, flat to very gently undulating surface with no gullies, rills, stone outcrops or other geomorphic microrelief features. Salt flats would be an example of areas with SRFs of 1.00; most smooth (non-rocky/stony) grasslands, meadows, pastures, and agricultural areas in temperate climates will have SRFs of 0.9 to 0.7. A highly dissected flood plain (even with a flat hard surface that is smooth between the gullies) would be given a medium to low SRF based on the analyst's estimate of the effect of the gullies on the movement of the various vehicle types. Thus, the SRFs often vary from one vehicle class to another.

e. An example of a surface roughness feature might be, "stony soil and ground surface". Some of the important characteristics to consider in estimating the degree of degradation would include size, shape, density, distribution, etc. of the stones. Obviously, if there were only a few scattered small, rounded, half buried stones, the factor would approach 1.00 indicating little degradation of speed, whereas increases in density, size, angularity, etc. would produce a smaller factor of 0.65, for example, with greater degradation of speed.

3.26.3.5 Surface roughness type numbers. The surface roughness type numbers 1 and 2 are standardized and are used as follows:

1 - No surface roughness effect
2 - Area of high landslide potential

3.26.3.5.1 No surface roughness effect.

a. Surface roughness type number 1, "No surface roughness effect", refers to a uniformly smooth, relatively flat non-paved surface that would not slow or otherwise hinder, either by the ride dynamics or the physical characteristics of the vehicle movement, the driving of a military vehicle at its maximum cross-country movement (off road) speed. These areas are coded with a two letter surface material type (USCS soil map unit) followed by the number 1, which is reserved for areas of no surface roughness effect.

b. The surface roughness factor for this type of area will always be 1.00. The sample legend, Appendix D, page 135, shows how this is presented in the Surface Roughness section of the legend.

3.26.3.5.2 Potential Landslide Areas. These are usually in upland positions where even light pressure or movement has a high probability of causing the area to collapse with a rapid down slope movement of a mass of rock and/or earth.

a. Areas with high potential for landslides are shown wherever they occur, even when not adjacent to roads or railroads. These areas are coded with a two letter surface material type (USCS soil map unit) followed by the number 2, which is reserved for areas of high landslide potential. These areas are relatively rare and usually make up only a small percentage of a project area.

b. The surface roughness factor for areas of high landslide potential will always be 0.00. The sample legend, Appendix D, page 135, shows how this is presented in the Surface Roughness section of the legend.

3.26.3.5.3 Remaining surface roughness type numbers. The analyst tailored surface roughness types begin with type 3 and are usually ordered according to their affect on the Large and Medium Tanks vehicle class category, beginning with the surface roughness type with the highest SRF (least degradation of speed) and proceeding to the lowest SRF (greatest degradation of speed). This serves as an aid to the standard DMA cross-country movement (CCM) product, which is based on the Main Battle Tank (usually the M-1 Abrams).

3.26.4 Depth of surface material.

a. Depth of surface materials will be determined from the interpretation of the evidence furnished from the collected sources. This evidence may be as specific as an on-site measurement or as general as that derived from analysis of aerial photography.

b. Surface materials less than 0.5 meters deep from the ground surface to underlying bedrock, caliche, indurated pans, fragipans, or other cemented pans are indicated by underlining the map unit code with symbol 104 (_____). Lack of a solid line under the map unit code indicates that the surface material is generally greater than or equal to 0.5 meters in depth

3.26.5 Soil moisture.

a. Soil moisture, or state of the ground, is an important consideration when planning tactical military operations. The soil moisture content from the surface of the soil to the depth of the critical layer for military vehicles, usually the layer 15 to 38 centimeters (6 to 15 inches) below the surface, has one of the most significant influences on soil trafficability during cross-country movement. Soil moisture conditions are dependent not only upon climatic conditions, such as temperature, precipitation, evapotranspiration, etc., but also upon USCS soil type properties, internal and external drainage characteristics, water table level, and topographic position. In addition, the natural soil moisture condition of the ground can be changed by human activities. For example, the water table in agricultural fields can be lowered through the use of drainage tiles or ditches, and water levels can rise due to dam construction and subsequent inundation of the reservoir area. Nevertheless, soil moisture category determinations will be made for all areas on this thematic overlay, exclusive of common open water (code W) and not-evaluated (code X) areas.

b. Since soil moisture conditions are related to the aforementioned climatic factors, they are normally very temporal and can rapidly change over a relatively short period of time. As the Surface Materials Overlay can only depict soil properties of a constant nature, potential soil moisture conditions and not actual soil moisture conditions are shown in the data base through the delineation of natural soil drainage categories (where soil drainage refers to the frequency and duration of periods when the soil is free of saturation). TTADB users can then integrate natural soil drainage categories with recent climatic data to determine the present state of the ground for a particular area.

c. Soil moisture evaluations for the Surface Materials Overlay normally are based on conditions expected to exist during periods of optimal trafficability for military operations. For most areas of the world, this is usually the dry season of the year when climatic and vegetative factors combine to produce

conditions of relatively high evapotranspiration and relatively low soil moisture. This is usually interpreted as a normal dry summer day, at least for temperate climates. The evaluation assumes no recent precipitation (within two to three days) or prolonged drought, which would distort the normal soil moisture condition.

d. If other optimal operational periods are selected, such as frozen soil conditions in an Arctic Tundra area (where the optimal operational period might be a frozen winter day with little or no snow cover) a statement to this effect shall be shown below the example in the soil moisture section of the legend.

e. The soil moisture (drainage) condition is described to a depth of at least 0.8 meters and is classified into the following three categories:

(1) Dry

(a) Dry conditions exist when the soil moisture content is less than that at field capacity, i.e., the amount of water held in the soil after excess gravitational or free water has drained away (usually two to three days after a soaking rain).

(b) Dry soils are well drained and exhibit good to moderate internal and external drainage characteristics without any influence from impervious pans, cemented layers, or other soil horizons restricting free water movement within the soil. Dry soils do not have physical indications of saturation by water, such as strongly mottled and gleyed soil horizons within 0.5 meters of the ground surface, nor do they have water tables within 0.8 meters of the surface.

(c) Dry soils usually occupy convex upland positions in the landscape, such as on ridges and upper slopes, where the depth to the water table is more than 0.8 meters most of the year. However, dry soils can also exist in many other landscape positions such as terrace slopes, upland toe slopes, upland flats, terrace flats, and flood plains that have well drained soil moisture conditions.

(2) Moist

(a) Moist conditions exist when the soil moisture content is greater than or equal to field capacity but less than the soil moisture content at the liquid limit, which is usually about 150 percent of field capacity.

(b) Soils with a potential for moist conditions throughout the year commonly have low chroma mottles (chroma <= 2) and grayish or bluish horizons, which are indicative of poor drainage, within 0.3 to 0.8 meters from the surface. The more mottled and gray the subsoil, the poorer the soil drainage. The more intense the mottles and the closer they are to the soil surface, the longer the period of saturation or the higher the water table.

(c) Potentially moist soils generally occupy low-lying and concave or depressed positions in the landscape where the water table is found at a depth of 0.3 meter to 0.8 meters from the surface for a significant portion of the year. These topographic sites are not only more susceptible to accumulating soil moisture after a precipitation event, but they also subsequently retain this moisture longer than other topographic positions in the landscape that have received equal amounts of precipitation. These sites can occur at the base of

slopes, in upland depressions, and on some floodplains, low terraces, or other low-lying land along watercourses.

(d) Soils with a potential for moist conditions can also exist in upland flats and other level areas that have soils with poor internal or external drainage. Moist conditions can also occur in soils with impervious pans or cemented layers that restrict percolation and cause perched water tables. In addition, soils influenced by seepage from down slope or lateral movement of water or underground springs can also exhibit moist soil conditions.

(3) Wet

(a) Wet conditions exist when the soil moisture content ranges from the soil's liquid limit to its maximum water holding capacity, which approaches complete saturation and is equal to approximately 200 percent of field capacity. A soil in a wet condition commonly has free standing water at or near the soil surface.

(b) Areas exhibiting wet soil conditions are commonly very poorly drained and waterlogged or flooded at least part of the year; often have surface accumulations of organic matter; have soil horizons immediately below the surface horizon that are mottled, gleyed, or both; and have water tables within 0.3 meters of the surface throughout most of the year. Soils in a wet condition frequently support hydrophytic vegetation and are commonly found in swamps, marshes, tidal flats, bogs, and other low-lying, perennially wet areas.

(c) Wet soils can also exist seasonally in level to nearly level upland flats with poor internal drainage or shallow, restrictive pans or impervious layers, or in sloping areas with soils that have very poor internal drainage, are affected by seepage, or both.

e. The three soil moisture categories described above are represented on the Surface Materials Overlay by underlining (or not underlining) the map unit codes with the following symbols:

(1) No underline indicates soils which are normally dry during the dry period of the year.

(2) A dashed underline (---------- , Symbol 105) indicates soils which are normally moist during the dry period of the year.

(3) A dotted underline (..... , Symbol 106) indicates soils which are normally wet during the dry period of the year.

f. One special case can occur where the map unit code has double underlining. This would occur where the soil is less than 0.5 meters deep and its soil moisture condition is normally moist or wet.

g. Notes detailing the state of the ground (normal seasonal moisture content variation of the ground) and the seasonal moisture condition of special or unique features will be added to the legend. Examples are located in the sample Surface Materials Overlay Legend in Appendix D, page 134.

3.26.6 Areal extent. Whereas surface materials are represented by an areal overlay, all areas within the neat line shall be assigned a map unit code. The minimum size polygon shown must have an areal extent of at least 20 square millimeters (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance) in the polygon's shortest dimension.

3.27 Obstacles. This section provides the basic guidance for the production of the Obstacles Overlay for the TTADB.

3.27.1 General obstacles information.

a. The treatment of obstacles is limited to any natural and/or man-made features that divert ground based military cross-country movement (CCM).

b. A sample Obstacles Legend and coding scheme are shown in Appendix D, page 144. Symbology is shown in Appendix B, pages 124 - 126.

3.27.2 Classification and definition of obstacles.

3.27.2.1 Obstacle types. All obstacles are classified into the following types:

3.27.2.1.1 Man-made linear obstacles.

a. **Road/Railroad Cut** (Symbol 700) - An excavation, with a side slope gradient > 60%, through earth and/or rock at a constant or smoothly changing grade or level which provides a passageway for a transportation feature such as a road, railroad, etc. Any non-transportation cuts, not otherwise covered on this thematic overlay, found in other types of excavations shall be shown also. Examples include the cut faces of quarries and mines and construction excavations.

b. **Road/Railroad Fill** (Symbol 701) - An embankment, with a side slope gradient > 60%, of earth and/or rock at a constant or smoothly changing grade or level constructed to provide a passageway for a transportation feature such as a road, railroad, etc. Any non-transportation fills, not otherwise covered on this thematic overlay, shall be shown also.

c. **Fence/Wall** (Symbol 702) - A long horizontal ground barrier which hinders or prevents ground movement by foot troops and/or vehicles. Some of the most common include:

(1) Fence (Wire or Wood) - A long line of relatively light structural material, such as chain linked, permanent concertina, or loosely strung barbed wire or wooden slats, high enough to block passage by vehicles or foot troops.

(2) Retaining Wall - A barrier of wood, steel, stones, boulders, concrete, or masonry which restrains the lateral pressure of the material behind it, usually soil or earth fill, from sliding. This category includes seawalls.

(3) Masonry Wall - A long line of relatively heavy material, such as stones, boulders or masonry, either loosely piled or cemented together and high enough (1.5m) to block passage by vehicles. This category includes breakwaters.

d. **Hedgerow** (Symbol 704) - A long row of closely spaced shrubs or a combination of shrubs and some trees enclosing or separating fields. They are used to mark field boundaries and to provide wind erosion protection. Depicted hedgerows are high enough (1.5m) and thick enough to block passage by vehicles or foot troops. Shrubs and trees may be growing on or around an earthen or stone foundation which adds to the obstacle effect.

e. **Embankment/Dike/Levee/Causeway** (Symbol 706) - A raised, solid linear, artificial structure, having some breath, with a slope/gradient > 60%, usually of earth or gravel, constructed above the surrounding natural ground level, used to hold back higher level water on one side (dike or levee) or to provide dry passage of a transportation feature across wet ground or water (causeway).

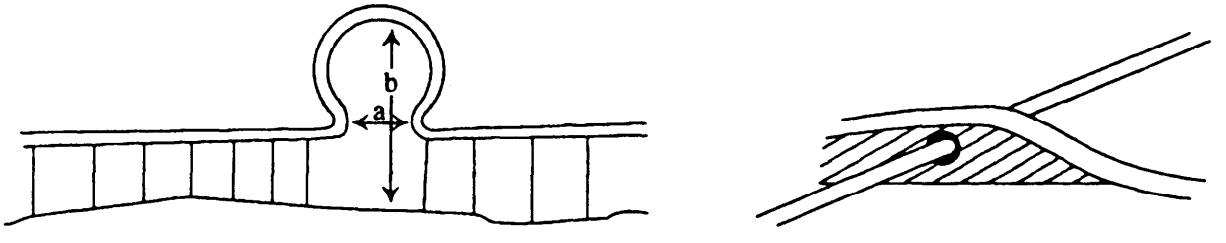
f. **Moat** (Symbol 707) - A long wide man-made ditch with steep masonry or earthen sides used to protect a built-up area or military strong point. The moat may be dry or contain water.

g. **Above Ground Pipeline** (Symbol 708) - Man-made conduits for water, oil, gas, or other fluids which rest on or are elevated above the ground. They are considered a hindrance to cross-country movement and thus shown on this thematic overlay, if they have either a ground height greater than or equal to 1.5 meters or less than 3.0 meters clearance beneath them.

h. **Pipeline Gap/Earth Filled Crossing Point** (Symbol 709):

(1) A pipeline gap is a looped arch in an on or above ground pipeline used to reduce the velocity and break up the force of the fluid in the pipeline. They will be shown if wide enough (>3.65m) and tall enough (>3.0m) to permit the passage of the main battle tank (M-1 Abrams). See examples in Figure 59.

(2) An earth filled crossing point is a mound of earth or gravel around and above a pipeline (or other linear obstacle) which permits the passage of military vehicles over the pipeline. These features are normally associated with a secondary or loose surface road and may themselves be paved or unpaved.



a. >3.65m Horizontal Clearance.
b. >3.0m Overhead Clearance.

FIGURE 59. Pipeline gap and earth filled crossing point.

3.27.2.1.2 Natural linear obstacles.

a. **Escarpment/Cliff** (Symbol 711).

(1) A natural relief feature characterized by a nearly vertical (slope/gradient > 80 to 90 degrees) to overhanging face of rock or earth of significant height and length (>1.5m high and >250m long in this case), separating two comparatively level or more gently sloping surfaces. Escarpments can be distinguished from embankments in that they are usually natural relief features, whereas embankments are usually man-made structures.

(2) As per 3.14.4.b., very steep (>60%), long (>5mm map or 250m ground distance), thin (<1mm map or 50m ground distance) slopes are shown as escarpments on the Obstacles Overlay. See Figure 55, page 69.

b. **Volcanic Dike** (Symbol 712) - A natural rock wall like structure generally formed by the erosion of softer materials on both sides of a narrow, vertical or nearly vertical, intrusion of very hard igneous or metamorphic materials.

3.27.2.1.3 Military obstacles. **Dragon's (Tiger) Teeth** (Symbol 716) - A row or series of rows of large concrete blocks or metal barriers designed to block vehicular movement, especially armored vehicles. They are often shaped like truncated pyramids or welded I-beams with their height and spacing designed to impede or "hang-up" vehicles attempting to cross them.

3.27.2.1.4 Natural and man-made areal obstacles.

a. For the Obstacles Overlay these features consist of rises and **depressions** (Symbol 717), such as mesas, craters, quarries, caves, mines, sink holes, land fills, etc., with steep (>60%) to nearly vertical walls. In order to be shown, these features must measure at least 5mm (250m ground distance) in their longest dimension or axis.

b. Since it is the obstacle effect of their side walls, cuts, fills, terracing, etc. which affects cross-country movement, all of these features will be treated as closed linear features (they may be broken at the point of access road ramps), even though they will be delineated to scale as an area feature. Rises will be shown with a closed fill symbol or escarpment symbol and depressions will be shown with their normal closed depression symbol or escarpment symbol.

3.27.2.2 Obstacle directivity. The teeth or ticks on any obstacle symbol with directivity, such as escarpments, embankments, cuts, fills, etc., shall always point downhill toward the base of the feature. The back of the symbol indicates the exact alignment of the feature along its uphill side.

3.27.2.3 Hydrologic obstacles. Hydrologic obstacles such as open water, drainage ditches, channelized streams, and river banks are shown on the Surface Drainage Overlay.

3.27.3 Depiction of obstacles.

a. Obstacles symbology is shown in Appendix B, pages 124 to 126.

b. Obstacle Size - The minimum sizes for obstacle features to be shown are > 1.5 meters high, > 250 meters long on the feature's main axis (5 mm at map scale), and > 60% slope.

c. One or more adjoining short obstacles with a combined length greater than 250 meters shall be shown. See Figure 60.

d. Delineated obstacles should be in non-urban areas where they are of primary importance for the diversion of cross-country movement of either vehicles or foot troops. Obstacles located in common urban areas normally will not be shown, unless they are the dominant feature in the area, such as high embankments, escarpments, or cliffs running through a city. Small numerous obstacles normally associated with urban areas, such as wooden or wire fences, small embankments, retaining walls, etc., generally will not be shown; however, city walls and major fortifications shall be shown.

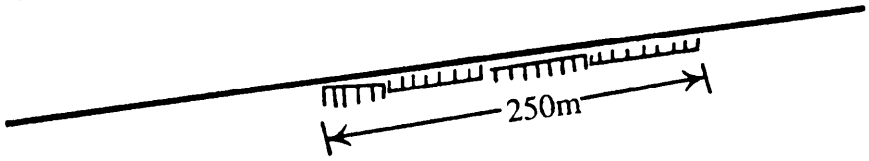


FIGURE 60. Combined obstacles meeting length requirement.

e. If obstacle locations can be accurately determined in areas of dense forest (75 - 100% canopy closure), on steep slopes (>60%), or within the gap width of streams, they shall be shown. For example: cuts, fills, and escarpments are portrayed in dense forests and on steep slopes.

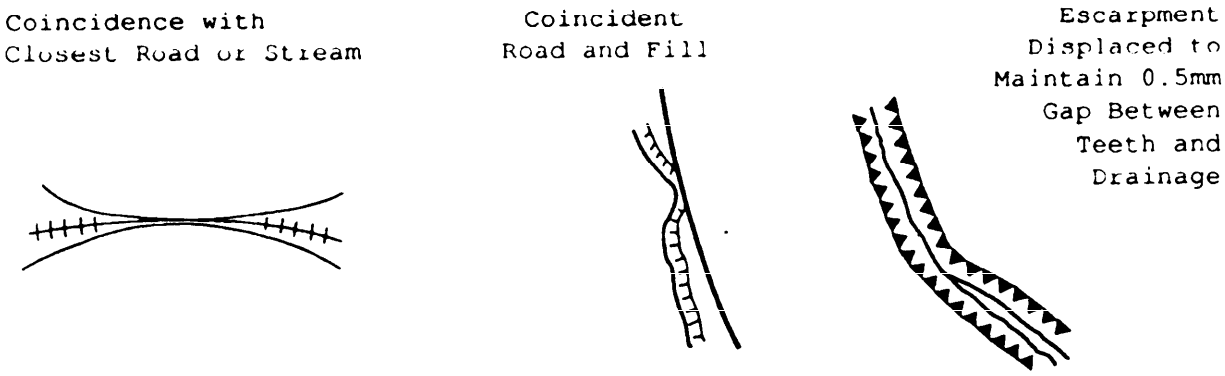
3.27.4 Displacement and/or breaking of obstacle features.

a. In order to prevent the overprinting of obstacles on transportation and surface drainage features when a CCM product is generated from the TTADB, the following normal displacement rules shall guide the positioning of obstacle symbols, unless supplementary guidance specifies otherwise:

(1) Obstacle symbols can be displaced in order of holding priority by surface drainage features (never moved), railroads (displaced only by drainage features) or roads (displaced by drainage features and railroads).

(2) Obstacle symbols are displaced such that a 0.5mm map scale gap is maintained between themselves or their directivity teeth/ticks and any surface drainage feature symbol representing a ground gap width between 4.5 and 142 meters. As both print magenta on the CCM map, the gap is necessary to distinguish between them. See Figure 61c.

(3) In places with dense or squeezed cartographic detail, an obstacle symbol can be displaced to the point where it is coincident with the closest transportation (preferred) or surface drainage feature. The length of the teeth or tick marks on directivity symbols will be shortened or eliminated in order to maintain a 0.5mm gap between them and the other symbol. If a smaller gap is shown on the base map, it may be used. See Figures 61a. and b. If it is not cartographically possible to show any of the teeth or ticks, the obstacle line will be labelled as to its identity, such as: escarpment, embankment, etc.



a. Embankment between two roads or streams.

b. Fill along road above stream

c. 4.5 - 142 m gap width streams in gorge with side walls >5m high.

FIGURE 61. Examples of "squeezed" obstacle symbols.

(4) The teeth or ticks of various obstacle features may print into common open water areas (which are blue on printed CCM maps). See Figure 62a.

(5) As surface drainage features equal to or less than 4.5 meters wide on the ground are not shown on the CCM product, coincident or overlapping obstacle symbols are not displaced for these features. See Figure 62b.

(6) Where transportation features are built on top of embankments or narrow fills (less than 0.25 mm or 12.5 meters on the ground exists between the edge of the transportation feature and the edge of the slope (or point of 'fall off'), the obstacle and transportation symbols can be coincident with each other.

a. Obstacles or teeth/ticks coincident with open water.

b. Obstacles or teeth/ticks coincident with stream <= 4.5 meters ground gap width.

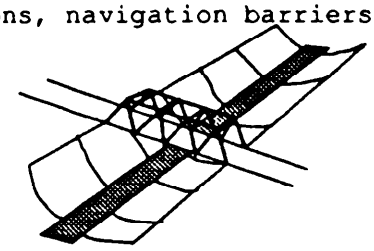
FIGURE 62. Example situations with no displacement of obstacle symbols for surface drainage features.

b. Generally, obstacle symbols will be broken with a gap of 0.5mm on each side of any transportation or surface drainage feature passing through them. However, the following special conditions shall override this rule:

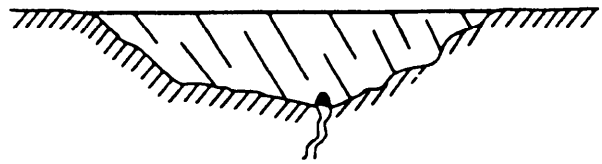
(1) In places where a transportation feature passes over an obstacle and its removal (such as a bridge over a narrow steep sided gully or road cut) would leave the obstacle intact, no break is made in the obstacle feature symbol. See Figure 63a.

(2) If a stream or road passes through a fill via a culvert or tunnel not large enough for an M-1 Abrams Tank (3.65 m wide or <3.0 m high) to traverse, the obstacle will not be broken. See Figure 63b.

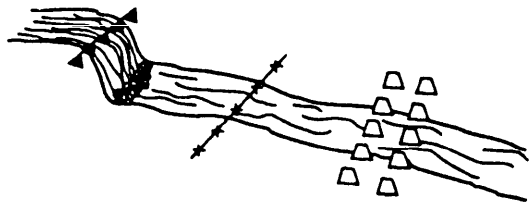
(3) Obstacles such as escarpments, dragon's teeth, fences, etc, will not be broken if they actually exist across a transportation or surface drainage feature (forming vehicle traps, waterfalls, rapids, dry season stream bed obstructions, navigation barriers, etc.). See Figure 63c.



a. Bridge over road cut



b. Fill across valley with non-traversable culvert or tunnel



c. Obstacles crossing streams

FIGURE 63. Example situations with no break in obstacles.

c. If an obstacle symbol is broken solely so it does not conflict with a transportation or surface drainage symbol actually passing through it when overlaid or overprinted with each other, both sides of the obstacle shall be shown, even if one or both sides are less than 5mm (250 meter ground distance) long. As an example, consider a fill across a valley with a traversable culvert or tunnel through it (see Figure 63b.). A gap of 0.5mm will be shown between the edges of the traversing symbol and the broken sections of the obstacle symbol. Total length of the obstacle before breaking must be greater than 5mm (250m ground distance).

d. Storm water management structures shall be shown as embankments. These normally earthen structures act as control devices for slowing flood waters and the major portion of their basins are dry during most of the year. The dam portion of the structure is shown on the Surface Drainage Overlay. See Figure 64.

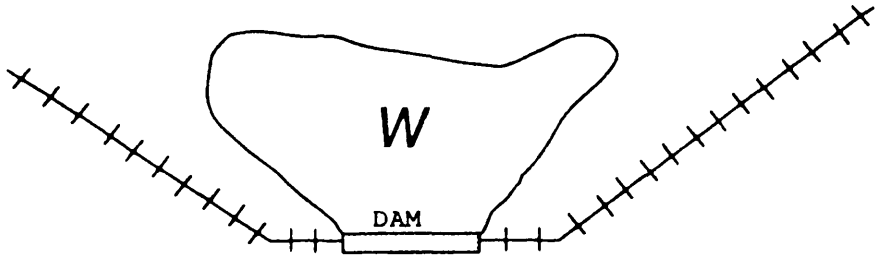


FIGURE 64. Storm water structure and dam.

e. Obstacles will not be displaced such that the true relative position of features to each other is misrepresented - such as a cut, fill, embankment, etc. being shown on the wrong side of a road or stream.

3.27.5 Miscellaneous obstacle features.

a. Additional obstacle features may be encountered which are a major hindrance or obstruction to military ground movement. In some geographic settings, features such as shelterbelts, on the ground aqueducts, elevated structures, kanats, wooded gullies, and permanent military obstructions, such as anti-tank ditches, impact areas, minefields, etc. may be of significance. As some production systems can handle only a limited number of miscellaneous items on each of the thematic overlays, care must be taken to show only those that would have a major impact on military operations.

b. Unless specified otherwise in Appendix I, depiction of these and/or other similar features may require modification of the legend and/or symbology in order to provide unique symbology of the feature. Where possible, standard (as defined by this specification) linear obstacle symbology will be used. If the feature requires unique symbology, standard symbols from the Military Specifications for 1:50,000 Scale Topographic Maps of Foreign Areas (MIL-T-89301) will be used to the maximum extent possible.

c. Appendix I defines and specifies the symbology to be used for most of the miscellaneous features which have been occasionally used on the various thematic overlays since the first edition TTADB specifications (PS/3JB/010) were published in January 1982.

3.27.6 Linear extent. The minimum length shown for an obstacle or combined obstacles shall be 5mm at map scale or 250 meters on the ground. The only exception being when an obstacle symbol long enough to be portrayed is broken solely so it does not conflict with a transportation or surface drainage feature passing through it when overlaid or overprinted with each other. In that case either one or both sides may be depicted as less than 5mm long. See 3.27.4c.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use

his or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Final product quality. Final product quality will reflect the quality expressed by each applicable military standard.

5. PACKAGING

5.1 Complete TTADB package. In addition to the six or more thematic terrain factor overlays covering a base map area, a complete TTADB package will also include a base map composite film positive made from the reproduction negatives used to produce the base map to which the overlays are keyed.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory).

6.1 Intended use. TTADB is a product developed to satisfy the armed services requirements for a cartographic presentation of Terrain Analysis data at the tactical scale.

6.2 Supersession. These specifications supersede the Defense Mapping Agency Product Specifications for the Hard Copy Tactical Terrain Analysis Data Base (TTADB), Scale 1:50,000, First Edition, January 1982 (PS/3JB/010).

6.3 International standardization agreements. Certain provisions of this specification are subject to international standardization agreements. When amendment, revision, or cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement, or make other appropriate accommodations.

6.3.1 International standardization agreements (STANAGs).

2251 MGD	-	Scope and Presentation of Military Geographic Information and Documentation (MGID), MAS(ARMY) 2254(78) 471.
2253 MGD	-	Military Geographic Documentation - Roads

and Road Structures, MAS(ARMY) (74) 862.
2254 MGD - Navigable Inland Waterways, MAS(ARMY) 2254(78) 471.
2256 MGD - Inland Hydrography, MAS(ARMY) (71) 867.
2257 MGD - RAILWAYS, MAS(ARMY) 2257(79) 491.

6.3.2 Quadripartite standardization agreements (QSTAGs).

This section is not applicable to this specification

6.3.3 Air standardization coordinating committee agreements (ASCC AIR STDs/ STDs/ADV PUBs).

This section is not applicable to this specification

6.3.4 International MC&G agreements.

This section is not applicable to this specification

6.3.5 Executive orders.

This section is not applicable to this specification

6.3.6 Inter-Agency agreements.

This section is not applicable to this specification

6.3.7 Other documentation.

This section is not applicable to this specification

6.4 TTADB definition. The Tactical Terrain Analysis Data Base (TTADB) is a 1:50,000 scale geographic information system type data base consisting of a set of selected single subject thematic terrain information overlays used to satisfy tactical military requirements. Data on the physical, biological and cultural features of the Earth's surface is presented either in a hard copy cartographic or digital format. These specifications cover only the cartographic presentation.

6.5 Content. The TTADB is limited to those natural and man-made features which are of tactical military significance. These features are depicted in a data base consisting of six or more terrain factor overlays which include Surface Configuration (Slope), Vegetation, Surface Materials (Soils), Surface Drainage, Transportation, and Obstacles. If the Transportation Overlay is overly congested, a second overlay may be required. In addition, a Stem Diameter/Tree Spacing/ Vegetation Roughness Table and a Bridge Information Table(s) may be provided on separate overlays as required by space limitations. The composite film positive of the base map is included in the complete package in order to provide users with a stable base for registering the overlays.

6.6 Utilization.

a. The thematic overlays are designed to provide basic terrain information to the user and to support the generation of a variety of synthesized products including but not limited to:

(1) Cross-Country Movement (CCM) - Main Battle Tank
(2) Concealment/Aerial Detection - Summer
(3) Concealment/Aerial Detection - Winter
(4) Drop Zones
(5 Landing Zones
(6) Nap of the Earth
(7) Line of Sight
(8) Horizontal Visibility
(9) Sensor Emplacement
(10) Ground Detection
(11) Potential Activities Areas
(12) Avenues of Approach
(13) War Game Simulation
(14) Operations Planning
(15) Intervisibility Studies
(16) Fields of Fire
(17) Airburst Effectiveness
(18) CCM - Any Vehicle (Friendly or Hostile)
(19) CCM - Foot Troops

b. TTADBs are produced for the normal conditions a military unit would expect to find on a dry day during the season with the most optimal climatic conditions for military operations. For most areas of the world, the best days of the year for military operations occur during the summer months. For areas where another season is optimal, a statement as to this time of the year shall be added to the thematic overlays.

6.7 Source material.

a. A critical component in the production of terrain analysis data bases is the proper utilization of available source materials. Imagery, especially aerial photography, is the primary tool used in the production of the TTADB.

b. Collateral sources are often as important as imagery. The following are some of the types of collateral materials which can be used in conjunction with imagery to produce the various terrain analysis data bases:

(1) DIA Automated Installation Intelligence File (AIIF)
(2) Books and Documents by Subject
(3) Topographic Maps
(4) Tourist Guides and Maps
(5) Terrain and Environmental Studies
(6) Land Use Maps and Studies
(7) Thematic Maps of Soils, Forestry, etc.
(8) Military Maps of Mobility, CCM, etc.
(9) Periodicals and Journals in the Various Disciplines
(10) Ground Photos
(11) Surveys of Soils, Forestry, etc.
(12) Foreign and U.S. produced Military Geographic Information and Documentation (MGID) Products
(13) Intelligence Surveys
(14) Stratigraphic Columns and Well Logs
(15) Multispectral Imagery Studies

(16) Thermal and Radar Sensor Data Reports
(17) Engineer Reconnaissance Reports, etc.
(18) Military Terrain Team Studies, TTADBs, Special Products, etc.

c. Precedence is given to imagery over collateral sources, except when collateral sources provide more detailed, documented and/or updated information than can be derived from the imagery.

6.8 Not-evaluated areas. The not-evaluated (NE) code is used in areas that cannot be classified because of a total absence of imagery or collateral sources. This code shall be used for these gap areas when it is impossible to extrapolate accurately from the surrounding areas. The areal extent of the not-evaluated code, if used at all, should normally cover only a small fraction of the overlay.

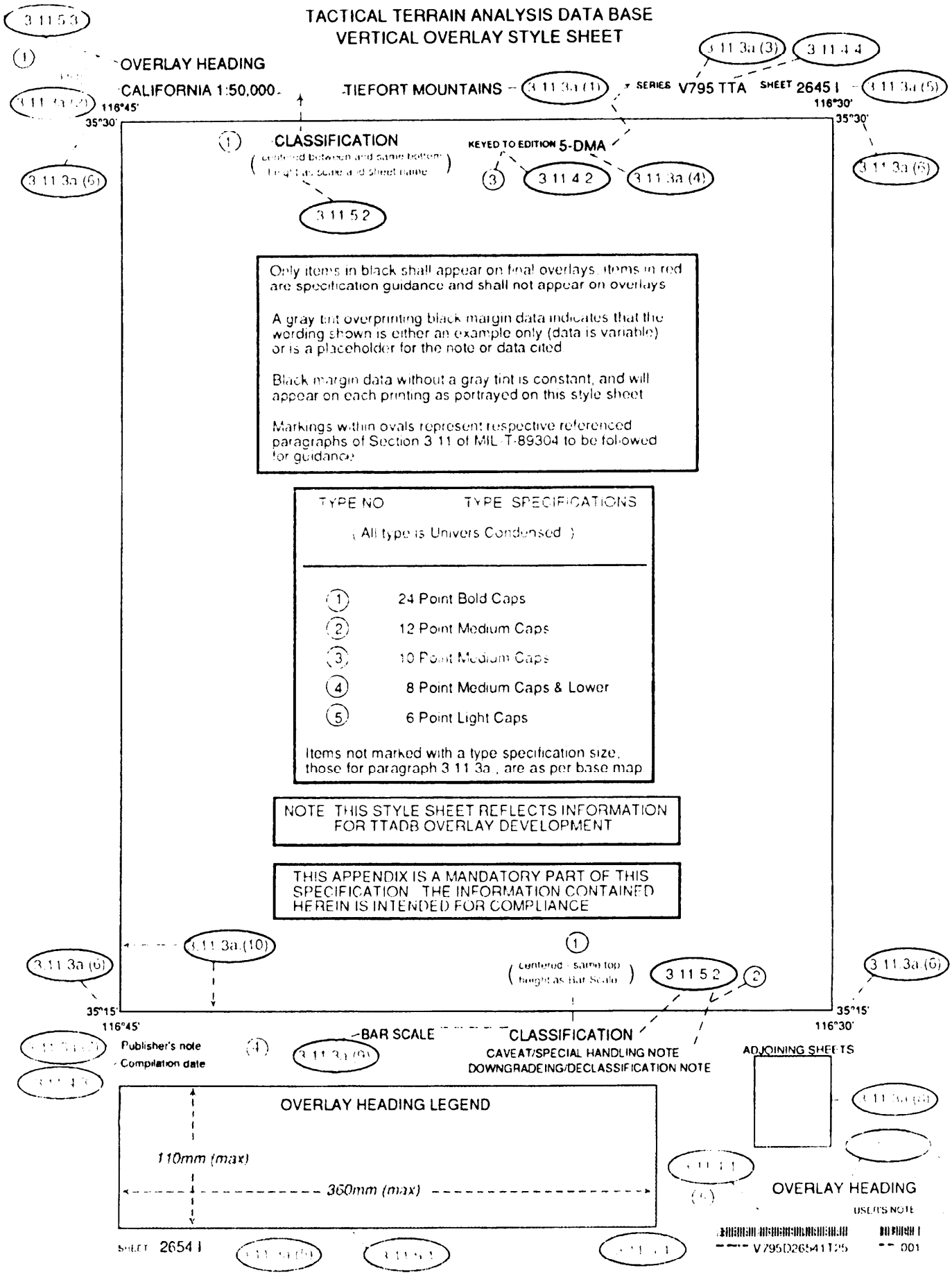
6.9 Classification and special handling of thematic overlays.

a. The classification of the final TTADB overlays will be determined by the appropriate security section responsible for the final classification. The lowest possible classification of the final product is desired.

b. Even though the final overlays might be unclassified, a handling caveat could be required. Some NATO and other countries have mapping and other agreements which dictate the handling of materials produced over their country. Security elements should check for caveat requirements at the beginning of each project.

6.10 Acquisition requirement. When this specification is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1).

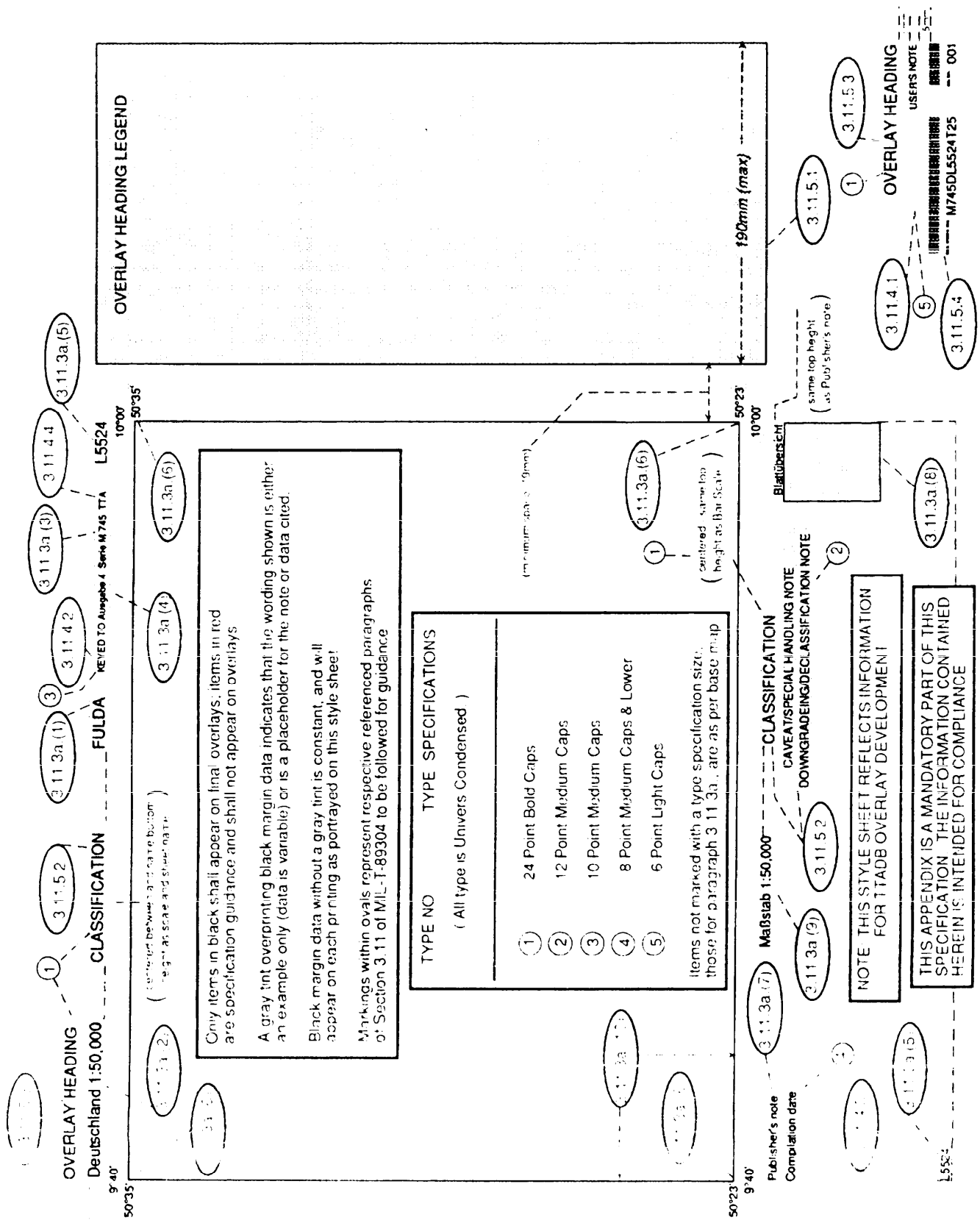
APPENDIX A



services conform to prescribed requirements.

APPENDIX A

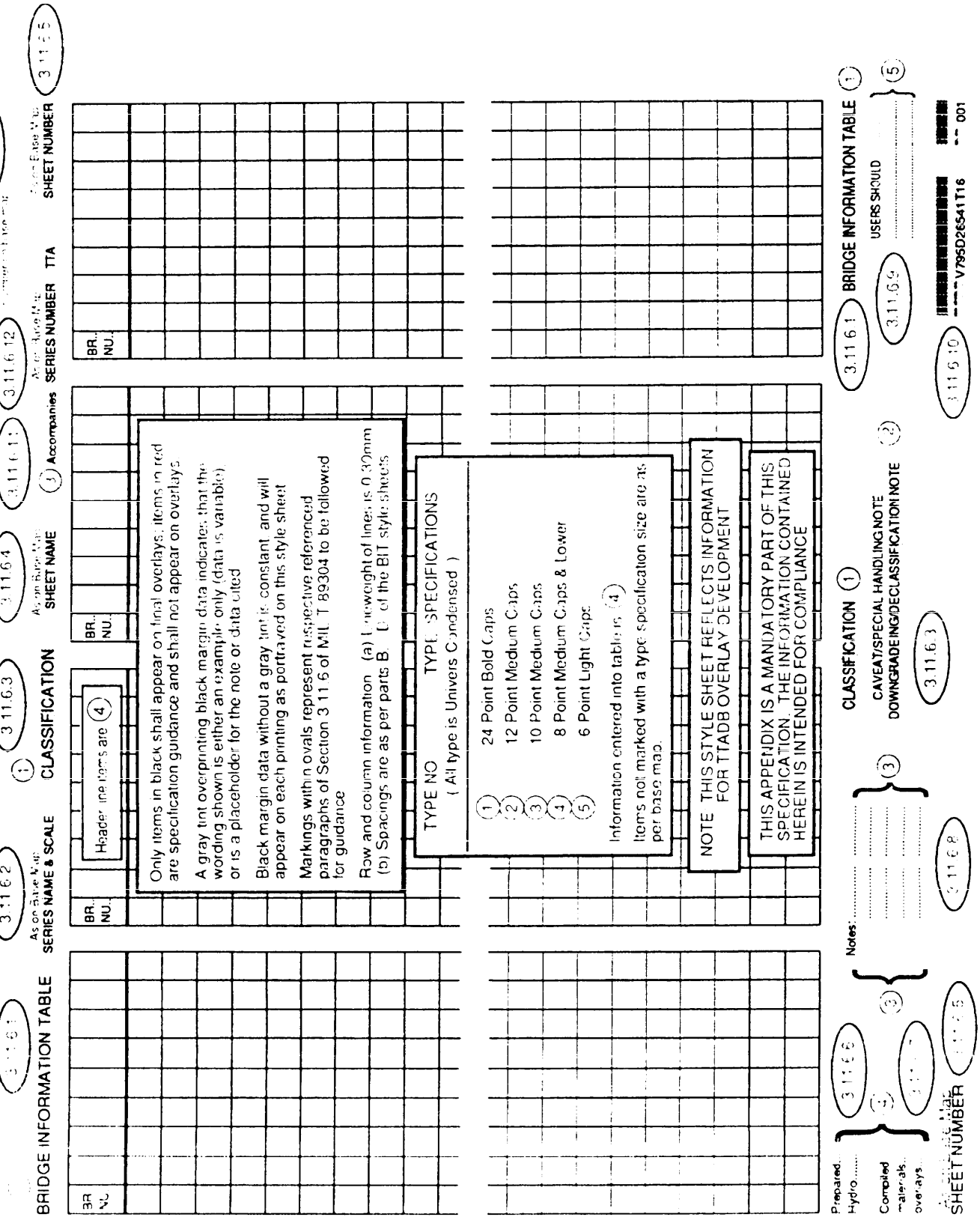
TACTICAL TERRAIN ANALYSIS DATA BASE
HORIZONTAL OVERLAY STYLE SHEET



APPENDIX A

TACTICAL TERRAIN ANALYSIS DATA BASE
BRIDGE INFORMATION TABLE STYLE SHEET

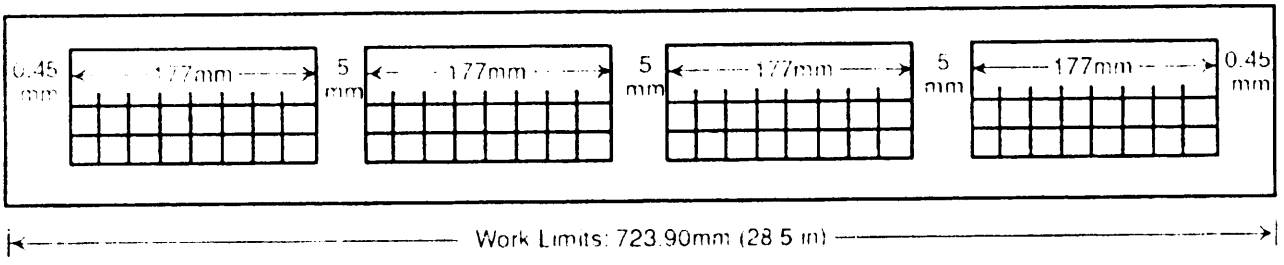
A. OVERALL BRIDGE INFORMATION TABLE (BIT) LAYOUT



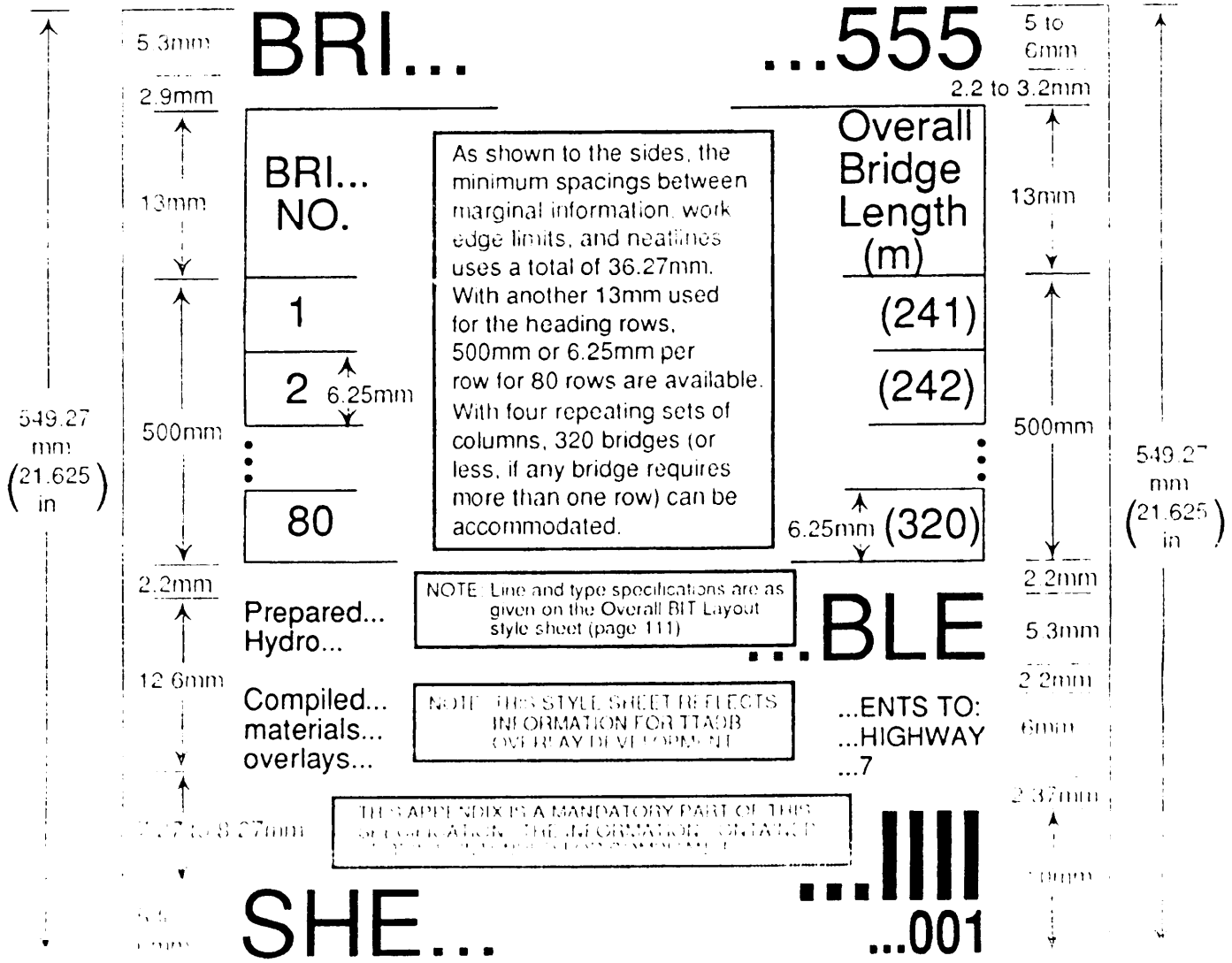
APPENDIX A

TACTICAL TERRAIN ANALYSIS DATA BASE
BRIDGE INFORMATION TABLE STYLE SHEET (Continued)

B. BIT AND COLUMNAR WIDTHS. Combining the work limits found in Appendix C yields 723.90mm (28.5 in) x 549.27mm (21.625 in) as the maximum size work limits for a 1:50,000 scale map sheet BIT, which will not change depending on the area of the world. As shown below, using this maximum size yields four columnar sets, each 177mm wide, with 5mm between sets of columns and 0.45mm on the ends to the edge of the maximum work limits.



C. BIT AND COLUMNAR HEIGHTS. Using the combined maximum size work limits defined above will also yield the following Bridge Information Table and columnar heights, as shown in the expanded view below:



APPENDIX A

TACTICAL TERRAIN ANALYSIS DATA BASE
BRIDGE INFORMATION TABLE STYLE SHEET (Continued)

D. COLUMNAR HEADERS. Individual column widths, header heights, and header labels within each columnar set are as shown below:

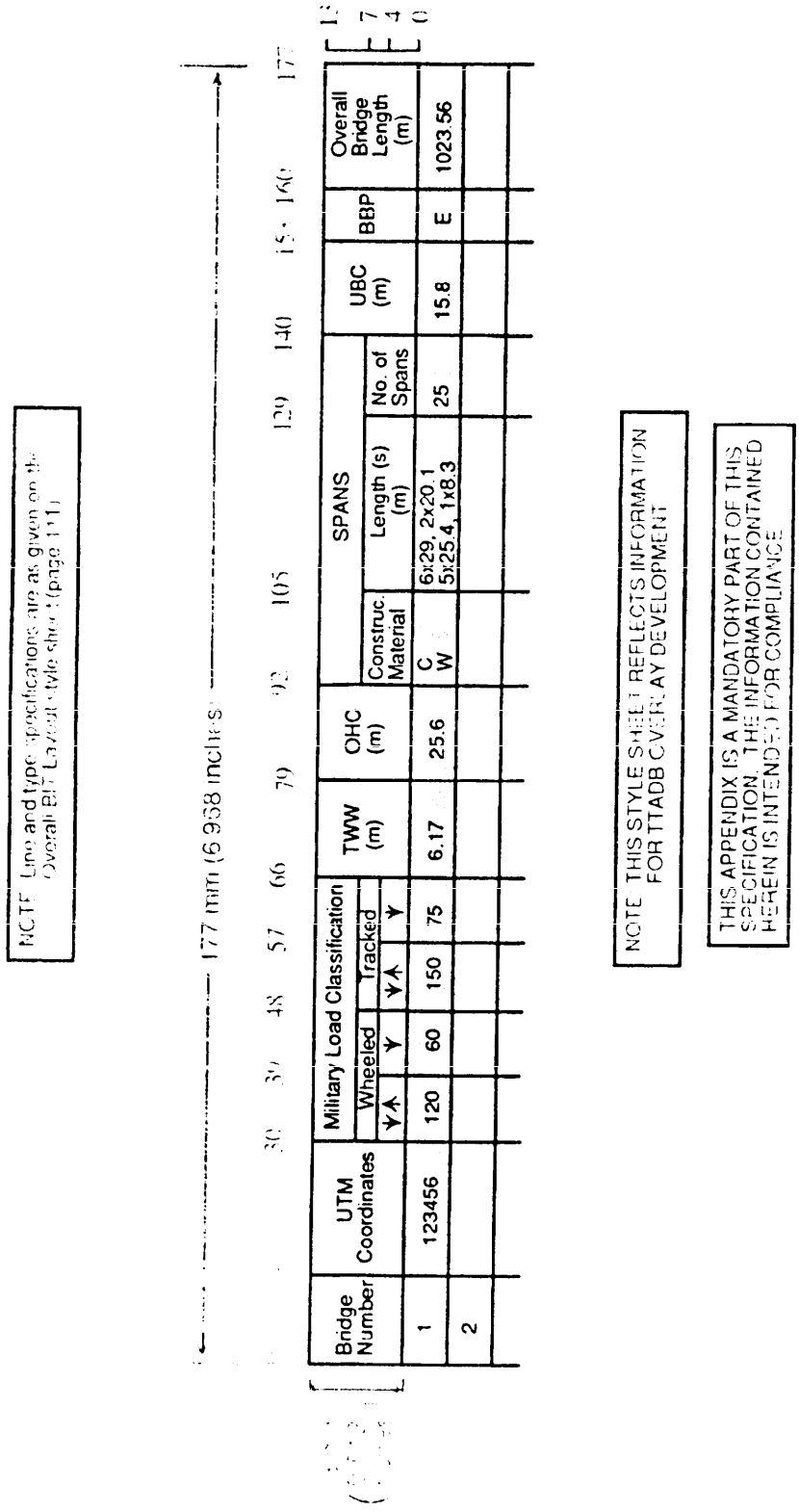


FIGURE 55. Depiction of steep, long, grip slopes

APPENDIX B

TTADB SYMBOLOGY

10. SCOPE

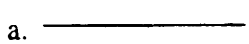
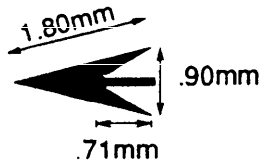
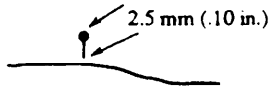
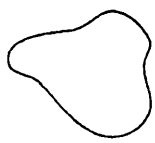
10.1 Scope. This appendix provides the specifications for the TTADB symbols. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. SYMBOLS

30.1 General symbols. Sidewings, arms, and/or tick spacings on any of the data information holders shall be extended beyond their normal 6.0mm length, as needed for longer or more detail numbers and/or letters.

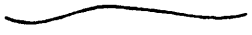
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Leaderlines	a. 	Lineweight: 0.20mm(.008in)	100
	b. 	a. Straight b. Cornered (Point to Point Angles)	
Arrowheads	a. 	Length: Longer sides:1.80mm (.071in) Short side: 0.90mm (.035in) Leaderline in line with point of arrowhead.	101
	b.	a. Enlarged b. Actual size	
Point of Change Marker		Ball on top of line Lineweight: 0.30mm (.012in) Line length: 1.5mm (.06in) Ball diameter: 1.0mm (.04in) DMA Posicut No. 1414	102
Polygons for: Surface Configuration (Slope), Vegetation, Surface Materials (Soils), Common Open Water, and Urban Areas		Lineweight: 0.30mm (.012in) Area: >=20 square millimeters (50,000 square meters (m^2) ground area) Width:>=1mm (0.04in) (50 meter (m) ground distance(gd)) Codes in Univers Caps, sized as per Appendix G	103

APPENDIX B

30.1 General symbols (Continued)

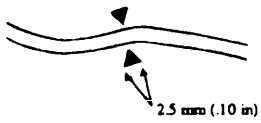
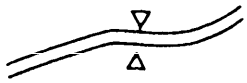
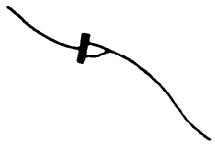
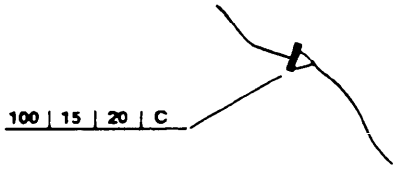
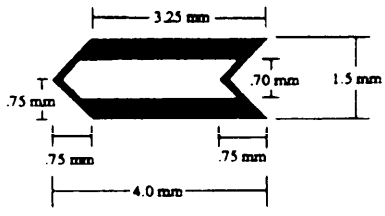
FEATURE	SYMBOL	SPECIFICATIONS
Lines for Underlining:		
Solid	———	Lineweight: 0.30mm (.012in
Dashes	- - - - - -	Lineweight: 0.30mm (.012in Dash length: 1.0mm (.04in) Space: 0.5mm (.02in)
Dots	.....	Dot diameter: 0.30mm (.012in Center spacing: 0.80mm (.032in

30.2 Surface drainage symbols.

FEATURE	SYMBOL	SPECIFICATIONS
Non-common Open Water		Polygon with letter "W" in Univers Caps inside Lineweight: 0.30mm (.012in Area: >2 square millimeters (10,000 m^2 ground area) Width: >=1mm (0.04in) (50m gd)
Canal, Channelized Stream, Irrigation Canal or Drainage Ditch (Gap width <=4.5m)	- - - - - -	Lineweight: 0.30mm (.012in Dash length: 1.0mm (.04in) Space: 0.5mm (.02in)
Stream (Gap width <=4.5m)		Lineweight: 0.30mm (.012in Dash: 2.0mm (.08in) Space: 1.0mm (.04in)
Stream or Canal (Gap Width > 4.5m <= 18m)		Lineweight: 0.30mm (.012in
Stream or Canal (Gap Width > 18m)		Plot to scale Lineweight: 0.30mm (.012in
Covered Drainage		Words "covered drainage" in 7 pt Univers Bold Cond. LC around dashed line Lineweight: 0.30mm (.012in Dash length: 2.0mm (.08in) Space: 1.0mm (.04in)

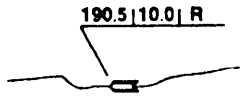
APPENDIX B

30.2 Surface drainage symbols (Continued)

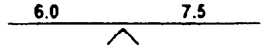
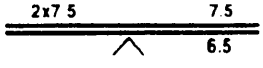
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Off Route Ford		Two solid equilateral triangles perpendicular to stream bank Length on each side: 2.5mm (.10in) DMA Posicut No. 1414	511
Float Bridge/ Raft Site		Two open equilateral triangles perpendicular to stream bank Lineweight: 0.30mm (.012in) Length on each side: 2.5mm (.10in)	512
Dam		Block across stream Plot to scale or minimum size: 1.0mm wide x 4.0mm long (.04in x .16in)	513
Dam Information Holder (Use with dams >= 5m high)		Baseline with ticks and letters and numbers in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Length: baseline: 24.0mm (.96in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in) Leader lineweight: 0.20mm (.008in)	514
Lock	 (Enlarged) (Actual size)	Arrow shaped parallelogram which points upstream Plot to scale Minimum overall size: 1.5mm wide x 4.0mm long (.06in x .16in) Long sides: Length: 3.25mm (.13in) Lineweight: 0.40mm (.016in) Short sides, length horizontally /vertically to tip of points: 0.75mm (.03in) Lineweight: 0.25mm (.01in) Angles across stream at 45°	516

APPENDIX B

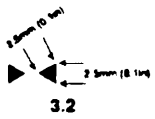
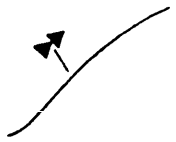
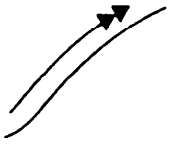
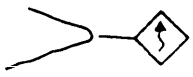
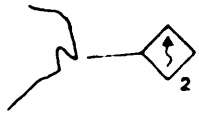
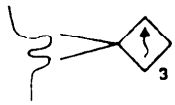
30.2 Surface drainage symbols (Continued)

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Lock Information Holder		Baseline with ticks and letters and numbers in 7 pt. Univers Bold Condensed Lineweight: 0.30mm (.012in) Length: baseline: 18.0mm (.71in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in) Leader lineweight: 0.20mm (.008in)	517
Drainage code	123456789	Nine digit number in 7 pt. Univers Bold Condensed	521

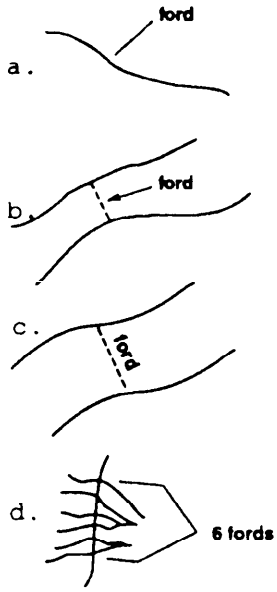
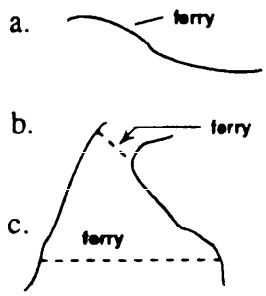
30.3 Transportation symbols.

FEATURE	SYMBOL	SPECIFICATIONS	NO.
All weather, dual/divided highway		Lineweight: 0.63mm (.025in) Minimum space: 0.25mm (.01in) Plot to scale if wider	600
All weather, hard surface road		Lineweight: 0.63mm (.025in)	601
All weather, loose surface road		Lineweight: 0.30mm (.012in)	602
Fair weather, loose surface road		Lineweight: 0.30mm (.012in) Dash: 5.0mm (.20in) Space: 1.0mm (.04in)	603
Track		Lineweight: 0.30mm (.012in) Dash: 2.0mm (.08in) Space: 0.5mm (.02in)	604
Road Width Change (Road width in meters)	a.  b. 	Carrot with numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length each side: 3.0mm (.12in) Sides slanted 45° to road and join at right angle	606

30.3 Transportation symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Road Width Change (Continued)		(Continued) DMA Posicut No. 1414 a. All road classes except dual lane. b. Dual/divided lane highways.	
Constriction (Width in meters)		Two solid equilateral triangles with numbers in 7 pt. Univers Bold Cond. Length on each side: 2.5mm (0.10in) DMA Posicut No. 1414	607
Steep Grade (> 7%)	a.  b.  c. 	Two solid adjoining equilateral triangles (tail, as needed) Lineweight: 0.30mm (.012in) Length on each side: 2.5mm (.10in) Length of tail plotted to scale if grade is longer than 4.3mm (215m gd) a. If < 2mm long (<100m gd) b. If 2 to 4.3mm long (100 - 215m gd) c. If > 4.3mm long (>215m gd), measured from tip of first triangle to end of tail)	609
Sharp Curve (radius <30 meters)	a.  b.  c. 	Square (diamond) with solid triangle and curved tail inside with numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Square/side: 5.0mm (.20in) Triangle on each side: 1.5mm (.06in) Tail lineweight: 0.20mm (.008in) a. Single curve b. Multiple curves within 2mm (100m gd) c. Multiple curves <= 5mm (250m gd) apart	610

30.3 Transportation symbols (Continued).

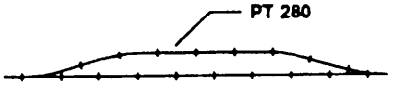
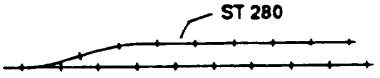
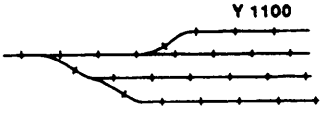
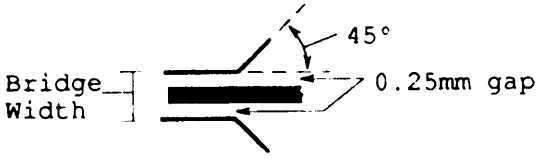
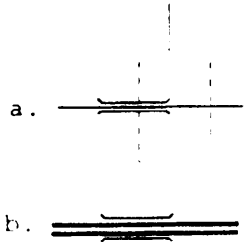
FEATURE	SYMBOL	SPECIFICATIONS	NO.
On Route Ford		Word "ford" or "fords" and number (as needed) in 7 pt. Univers Bold Cond. LC If >= 2mm (>= 100m gd) include dashed line showing route: Lineweight: 0.30mm (.012in) Dash length: 1.0mm (.04in) Space: 0.50mm (.04in) a. < 2mm (100m gd) b. >= 2-6mm (100 - 300m gd) c. > 6mm (300m gd) d. Multiple fords <= 5mm (250m gd) apart	611
Ferry		Word "ferry" in 7 pt. Univers Bold Cond. LC Lineweight: 0.30mm (.012in) Dash length: 1.0mm (.04in) Space: 1.0mm (.04in) a. < 2mm (100m gd) b. >= 2-6mm (100-300m gd) c. > 6mm (300m gd)	612
Feature Under Construction		Circle with letters "UC" in 7 pt. Univers Bold Condensed (Cond.) Caps inside Lineweight: 0.30mm (.012in) Circle diameter (dia.): 6.0mm (.24in) DMA Posicut No. 1414	613
Single Track, Normal Gauge		Lineweight: 0.30mm (.012in) Tick space: 5.0mm (.20in) Tick length: 1.0mm (.04in)	614
Multiple Track, Normal Gauge		Lineweight: 0.30mm (.012in) Tick space: 5.0mm (.20in) Tick length: 1.0mm (.04in) Space between multiple ticks: 0.50mm (.02in)	615

APPENDIX B

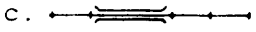
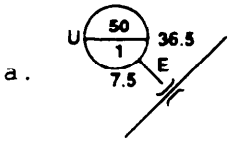
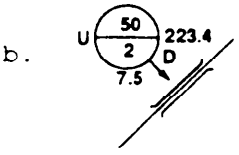
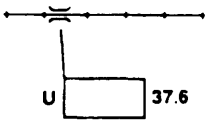
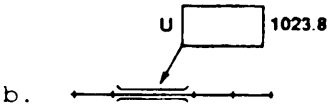
30.3 Transportation symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Narrow Gauge a.		Lineweight: 0.30mm (.012in) Tick space: 5.0mm (.20in) Tick length: 0.5mm (.02in) Space between ticks of a multiple pair: 0.50mm (.02in) a. Single track b. Multiple track	616
b.			
Broad Gauge a.		Word "broad" in 7 pt. Univers Bold Cond. LC above any railroad symbol Lineweight: 0.30mm (.012in) Tick space: 5.0mm (.20in) Tick length: 1.0mm (.04in) Space between ticks of a multiple pair: 0.50mm (.02in) a. Single track b. Multiple track	617
b.			
Electrified Line a.		Two small dots above every other cross tick or pair of cross ticks Dot diameter: 0.50mm (.02in) Space between Dots: 0.50mm (.02in) Dot pair space: 10.0mm (.4in) Dot bottom height above tick: 0.10mm (.004in) a. Normal gauge, single track b. Normal gauge, multiple track c. Narrow gauge, single track d. Narrow gauge, multiple track e. Broad gauge, single track f. Broad gauge, multiple track	618
b.			
c.			
d.			
e.			
f.			

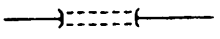
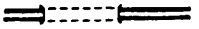
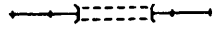
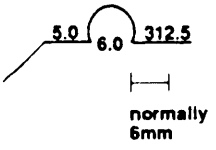
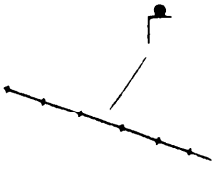
30.3 Transportation symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Dismantled Railroad		Lineweight: 0.30mm (.012in) Tick Space: 7.0mm (.28in) Tick Length: 0.5mm (.02in) Dash: 5.0mm (.20in) Space: 2.0mm (.08in)	620
Passing Track >= 280m (total track length in meters)		Letters "PT" followed by ground length in meters in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Tick Space: 5.0mm (.20in) Tick Length: 1.0mm (.04in) Leader lineweight: 0.20mm (.008in)	621
Siding >= 280m (total track length in meters)		Letters "ST" followed by ground length in meters in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Tick Space: 5.0mm (.20in) Tick Length: 1.0mm (.04in) Leader lineweight: 0.20mm (.008in)	622
Yard >= 280m (total track length in meters)		Letter "Y" followed by ground length in meters in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Tick Space: 5.0mm (.20in) Tick Length: 1.0mm (.04in)	623
Bridge	 (Enlarged view) 	Parallel lines with wingticks Plot to scale or minimum length between wingticks: 2.0mm (.08in) Wingtick length: 0.6mm (.024in) Wingtick Angle: 45° Lineweight: 0.30mm (.012in) Space between sides: Same as width of overall crossing road or railroad symbol plus 0.25mm (.01in) space on each side (Continued)	626

30.3 Transportation symbols (Continued).

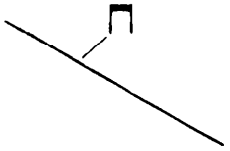
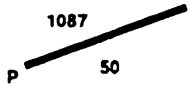
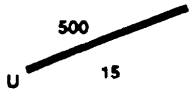
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Bridge (Continued)	c. 	Cross ticks of railroad symbol(s) are not shown on bridge a. = Non-dual lane road bridge b. = Dual lane divided highway bridge c. = Railroad bridge	
Road Bridge Information Holder	a.  b. 	Circle with surrounding letters and numbers in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Circle dia.: 7.0mm (.28in) Leader lineweight: 0.20mm (.008in) DMA Posicut No. 1414 a. Bridge length < 2mm (<100m gd) b. Bridge length >=2mm (>=100m gd)	627
Railroad Bridge Information Holder	a.  b. 	Rectangle with letters and numbers in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (0.012in) Rectangle size: 5.0mm x 10.0mm (0.20in x 0.40in) Leader lineweight: 0.20mm (.08in) a. Bridge length <2mm (100m gd) b. Bridge length >=2mm (100m gd)	628

30.3 Transportation symbols (Continued).

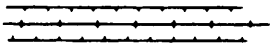
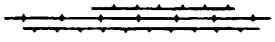
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Tunnel	a. 	Entranceway lines across feature with wingticks and parallel dashed lines between them Plot to scale or minimum size: Minimum length between entranceways: 2.0mm (.08in) Minimum entranceway line length: 1.5mm (.08in) Lineweight: 0.30mm (.012in) Wingtick length: 0.6mm (.024in) Wingtick angle: 45° Dashed line: 1.0mm (.04in) Space: 0.5mm (.02in) Associated transportation symbol is suppressed inside tunnel. a. Highway/Road tunnel b. Dual/divided highway tunnel. Plot width the same as overall highway width. c. Railroad tunnel	631
	b. 		
	c. 		
Tunnel Information Holder		2/3 Circle with sidewings and numbers in 7 pt. Univers Bold Cond. Caps Lineweight: 0.30mm (.012in) Circle dia.: 6.0mm (.24in) Sidewings: 6.0mm (.24in) Leader lineweight: 0.20mm (.008in) DMA Posicut No. 1414 Sidewings may be extended as needed for long numbers	632
Side Drop		Solid ball centered and touching horizontal line with vertical support leg Lineweight: 0.30mm (.012in) Ball diameter: 1.5mm (.06in) Line length: Top: 3.0mm (.12in) Leg: 3.5mm (.14in) Leader lineweight: 0.20mm (.008in)	635

APPENDIX B

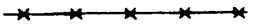
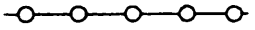
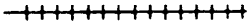
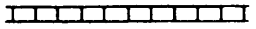
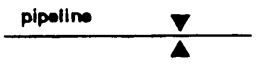
0.3 Transportation symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Overhead Drop		Solid block supported on two vertical legs Lineweight: 0.30mm (.012in) Top line: Width: 1.0mm (.04in) Length: 3.0mm (.12in) Leg line length to top of horizontal line: 4.0mm (.16in) Leader lineweight: 0.20mm (.008in)	636
Airfield Runways	a.  b. 	Heavy line with letters and numbers in 7 pt. Univers Bold Cond. Caps Orient and plot to scale Minimum width: 1.0mm (.04in) a. = Paved b. = Unpaved	638

30.4 Obstacle symbols.

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Road or Railroad Cut		Line with ticks pointing downhill, usually at a transportation feature Lineweight: 0.30mm (.012in) Tick Length: 0.50mm (.02in) Tick Space: 3.0mm (.12in)	700
Road or Railroad Fill		Line with ticks pointing downhill, usually away from a transportation feature Lineweight: 0.30mm (.012in) Tick Length: 0.50mm (.02in) Tick Space: 3.0mm (.12in)	701

30.4 Obstacle symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Fence/Wall		Cross ticks on line Lineweight: 0.30mm (.012in) Tick length: 2.0mm (.08in) Cross tick space: 7.0mm (.28in) Ticks meet at center of line, perpendicular to each other and at 45° angle to line. Must have at least one set of cross ticks per line. DMA Posicut No. 1414	702
Hedgerow		Circles on line Lineweight: 0.30mm (.012in) Circle Dia.: 2.0mm (.08in) Line length between circles: 4.0mm (.16in) DMA Posicut No. 1414	704
Embankment/Dike		Perpendicular cross ticks on line Lineweight: 0.30mm (.012in) Tick Length: 2.0mm (.08in) Tick Space: 2.0mm (.08in)	706
Moat		Sectioned parallel lines Lineweight: 0.30mm (.012in) Long line spacing: 2.0mm (.08in) Short line spacing: 3.0mm (.12in)	707
Pipeline (Above Ground)		Word "pipeline" in 7 pt. Univers Bold Cond. LC above line Lineweight: 0.30mm (.012in)	708
Pipeline Gap/Earth Filled Crossing Point		Two solid equilateral triangles Length each side: 2.5mm (.10in)	709

APPENDIX B

30.4 Obstacle symbols (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Escarpment		Baseline with solid triangles Lineweight: 0.30mm (.012in) Triangles, length of each side: 1.5mm (.06in) DMA Posicut No. 1414 Where escarpments curve in on themselves, every other triangle may be omitted.	711
Volcanic Dike (wall like)		Heavy line Lineweight: 0.45mm (.018in)	712
Dragon's Teeth		Small squares on line Lineweight: 0.30mm (.012in) Squares, length each side: 1.0mm (.04in) Line length: 4.0mm (.16in)	716
Depression		Inward facing ticks on line Lineweight: 0.30mm (.012in) Tick Length: 0.50mm (.02in) Tick Space: 3.0mm (.12in)	717

APPENDIX C

SIZE LIMITS FOR 1:50,000 MAP SHEET

10. SCOPE

10.1 Scope. This appendix provides the size specifications for the base maps to which the TTADB's are keyed. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this Appendix.

30. SIZE LIMITS

30.1 Size limits.

a. Standard maximum work limits are 558.80 mm x 723.90 mm (22.0 in x 28.5in).

b. Trim size pertains to the overall dimensions to which a map is cut after printing. Standard trim size is 571.50 mm x 736.60 mm (22.5 x 29.0 in).

c. On maps produced for use in NATO areas of interest, the maximum work limits are 549.27 mm x 733.42 mm (21.625 in x 28.875 in) and the trim limits are 558.80 mm x 736.60 mm (22.0 in x 29.0 in).

d. At the prerogative of the reproduction element, the 736.60 mm (29.0 in) standard trim limit for non-NATO maps may be increased, but not to exceed 762.00 mm (30.0 in).

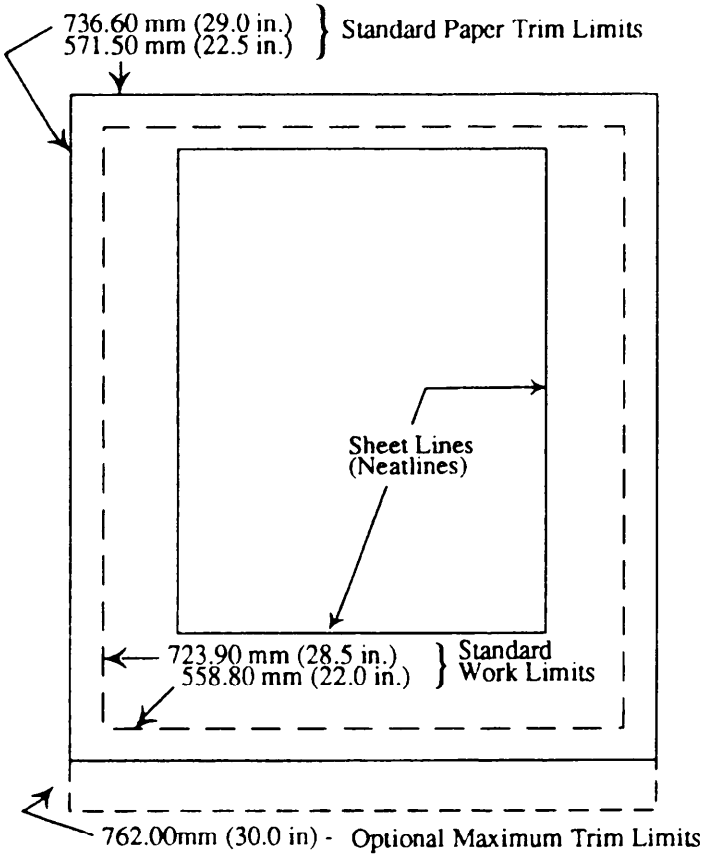
e. See diagrams on next page.

terrain analysis data bases ... critical component in the production of

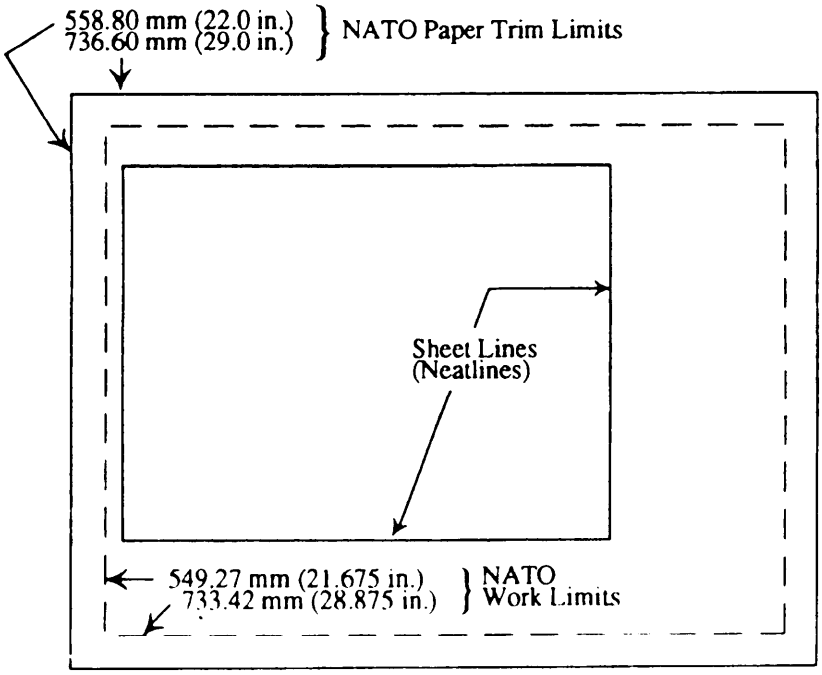
APPENDIX C

30.1 Size limits. (Continued)

a. Standard Map Sheet Sizes (Not to scale)



b. NATO Map Sheet Sizes (Not to scale)



APPENDX D

TTADB LEGENDS

10. SCOPE

10.1 Scope. This appendix provides the legends for the TTADB thematic overlays. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. LEGENDS

30.1 Use of legend appendix. Note that some of the information contained in the various legends of this appendix are noted as example data or statements only. When so noted, this data is either omitted from the thematic overlays because it does not appear in the project area or must be specifically tailored to meet the conditions that are relevant to the project area.

30.2 Surface configuration legend.

SURFACE CONFIGURATION (SLOPE) LEGEND — 14pt. Caps

MAP UNIT CODE	SLOPE (%)
A	0 - 3
B	3 - 10
C	10 - 20
D	20 - 30
E	30 - 45
F	>45
Y	Naturally and/or culturally dissected land (0 - >45)
W	Open Water

12pt. Caps

10pt. C/l

NOTE: All type is 113A, sizes indicated.

APPENDIX D

30.3 Vegetation legend.

VEGETATION LEGEND

14pt. Caps

MAP UNIT CODE	TYPE
A1	Agriculture (dry crops)
A2	Agriculture (wet crops)
A3	Agriculture (terraced crops, both wet & dry)
A4	Agriculture (shifting cultivation)
B1	Brushland (<5m high, open to medium spacing)
B2	Brushland (<5m high, medium to dense spacing)
C**	Evergreen/Coniferous Forest
D**	Deciduous Forest
E**	Mixed Forest (Evergreen/Deciduous)
FC**	Evergreen/Coniferous Orchard/Plantation/Nursery
FD**	Deciduous Orchard/Plantation/Nursery
FE**	Mixed Orchard/Plantation/Nursery
FP**	Palm Orchard/Plantation/Nursery
G1	Grassland, Pasture, Meadow
G2	Grassland with Scattered Trees, some Scrub Growth
H	Forest Clearing (cutover areas, burns, etc.)
IC*	Swamp (Coniferous/Evergreen)
ID*	Swamp (Deciduous)
IE*	Swamp (Mixed)
IM*	Swamp (Mangrove)
J	Marsh/Bog (treeless bogs, muskegs, etc.)
K	Wetlands (land subject to inundation)
L	Vineyards/Hops/Ginseng
M	Bamboo/Wild Cane
N	Bare Ground
W	Common Open Water
X	Common Built-up Area

12pt. Caps

10pt. C/1

* These vegetation types are given a three digit map unit code. In addition to the letter(s) for the type code, a number is added as the canopy closure code.

** These vegetation types are given a three or four digit map unit code. In addition to the letter(s) for the type code and a first number for canopy closure, a second number is added as the height code. See the Canopy Closure Table, Height Table, and example below.

10pt. C/1

NOTE: All type is 113A, sizes indicated.

30.3 Vegetation legend (Continued).

CANOPY CLOSURE TABLE

MAP UNIT CODE	CANOPY CLOSURE (%)
1	0 - 25
2	25 - 50
3	50 - 75
4	75 - 100

HEIGHT TABLE

MAP UNIT CODE	HEIGHT (meters)
1	0 - 2
2	2 - 5
3	5 - 10
4	10 - 15
5	15 - 20
6	20 - 25
7	25 - 30
8	30 - 35
9	>35

UNDERGROWTH

———————— Dense undergrowth

(No underline indicates sparse undergrowth or the presence and/or density of undergrowth is unknown)

Example: D23 indicates Deciduous Forest with canopy closure of 25 - 50%, height 5 - 10m, and dense undergrowth.

NON-FORESTED AREAS VEGETATION ROUGHNESS FACTORS*

MAP UNIT CODE	VEGETATION ROUGHNESS FACTOR (VRF - Summer)
A1	.90
A4	.50
B1	.90
B2	.85
G1	.90
G2	.70
H	.60
IC3	.25
ID4	.10
J	.80
W	Open Water (Not evaluated for VRF)
X	Built-up Area (Not evaluated for VRF)

* Examples only, all factors must be tailored for each project.

NOTE: All type is 113A, sizes indicated.

30.3 Vegetation legend (Continued).

TREE SPACING (m) -- STEM DIAMETER (cm) -- VEGETATION ROUGHNESS TABLE * 12 pt. Caps

FOREST TYPE AND CANOPY CLOSURE 10 pt. Caps

HEIGHT CODE	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2	E3	E4	FD1*	FD2*	FD3*	FD4*	F_1*	F_2*	F_3*	F_4*
1																				
2																				
3										4.86 15.2 .70										
4																				
5																				
6																				
7																				
8																				
9																				

Entries in table are 8 pt.

Example : E23 indicates the following: 4.86 m - Average Tree Spacing
15.2 cm - Average Stem Diameter
.70 - Vegetation Roughness Factor (VRF - Summer)

10 pt. C/1

* Examples only, tailor as necessary for each project area.
NOTE: All type is 113A, sizes indicated.

30.4 Surface materials legend.

SURFACE MATERIALS LEGEND — 14pt. Caps

SOIL TYPE — 12pt. Caps

MAP UNIT CODE (1ST TWO DIGITS)	DESCRIPTION — 12pt. Caps
GW	Well-graded gravels, gravel-sand mixture, little or no fines.
GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well-graded sand, gravelly sands, little or no fines.
SP	Poorly graded sands or gravelly sands, little or no fines.
SM	Silty sands, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures. — 10pt. C/1
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity.
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
CH	Inorganic clays of high plasticity, fat clays.
OH	Organic clays of medium to high plasticity, organic silts.
PT	Peat and other highly organic soils.
EV	Evaporites.
PS	Permanent snowfields.
RK	Rock outcrops.
X	Not evaluated (common urban areas and other man altered surfaces where USCS determination can not be made)
W	Common Open Water

NOTE: All type is 113A, sizes indicated

30.4 Surface materials legend (Continued).

SOIL DEPTH — 12pt. Caps

_____ < 0.5 meters — 10pt. L/C

(No underline indicates soil depth is > 0.5 meters)

SOIL MOISTURE — 12pt. Caps

---------- Soil normally moist
..... Soil normally wet — 10pt. L/C

(None of the above indicates soils are normally dry)

Example: Map unit code SC3 = Clayey sands, sand-clay mixtures, stony with scattered surface rock, normally moist, depth < 0.5 meters.

STATE OF THE GROUND* — 12pt. Caps

(1) Normal seasonal moisture content variation of the ground is:

Dry - March, June through October
Moist - April and November
Wet - May
Frozen - December through February — 10 pt. C/1

Note: Optimal operational period is a normal dry winter day with little or no snow cover.

(2) Map unit codes CL4 and OL4 represent rice paddy soils with the following seasonal moisture characteristics:

Dry - None
Moist - March, April and November
Wet - May through October
Frozen - December through February

*Examples only, all notes must be tailored for each project.

NOTE: All type is 113A, sizes indicated.

(The following is an example only. All surface roughness legends must be individually tailored for each project area. Headings are 12pt. Caps and entries are 10pt. C/l.)

SURFACE ROUGHNESS TABLE

MAP UNIT CODE (3RD/4TH DIGIT)	SURFACE ROUGNESS DESCRIPTION	ESTIMATED SURFACE ROUGHNESS FACTORS*				
		MEDIUM & LARGE TANKS	LARGE WHEELED VEHICLES	SMALL WHEELED VEHICLES	SMALL TRACKED VEHICLES	FOOT TROOPS
0	No Data	-	-	-	-	-
1	No surface roughness effect	1.00	1.00	1.00	1.00	1.00
2	Area of high landslide potential	0.00	0.00	0.00	0.00	0.00
3	Stony soil with scattered surface rock	0.90	0.90	0.95	0.95	0.95
4	Area of numerous diked fields	0.15	0.00	0.00	0.10	0.10
5	Quarries	0.35	0.10	0.10	0.25	0.25
6	Area of numerous terraced fields	0.25	0.00	0.00	0.10	0.10
7	Extensive surface rock & boulders with scattered thin soil	0.45	0.20	0.20	0.40	0.40
8	Moderately dissected	0.75	0.75	0.65	0.65	0.65
9	Highly dissected	0.25	0.30	0.10	0.20	0.20
10	Area of numerous sinkholes	0.45	0.55	0.50	0.55	0.55
11	Area of hummocky terrain	0.75	0.65	0.65	0.75	0.75
12	Rugged terrain with numerous outcrops	0.10	0.10	0.05	0.05	0.05
13	Salt evaporators with numerous dikes	0.05	0.05	0.00	0.00	0.00
14	Area of numerous walls	0.25	0.05	0.05	0.15	0.15
15	Area of shallow meander scars	0.90	0.80	0.75	0.85	0.85
16	Area of numerous canals/or ditches	0.60	0.40	0.45	0.50	0.50
17	Area of numerous hedgerows	0.40	0.10	0.05	0.15	0.15
18	Area of many small pits and quarries	0.30	0.35	0.40	0.40	0.40
19	Rock outcrops	0.35	0.10	0.10	0.25	0.25
20	Wadis with transverse sand ridges	0.45	0.35	0.40	0.40	0.40
21	Lava plain, rough rocky surface	0.10	0.05	0.00	0.05	0.05
22	Agricultural allotment area, wooden fences, numerous small enclosed areas	0.50	0.30	0.15	0.40	0.40

*Surface roughness factors are indicated with 0.00 having maximum and 1.00 having the least impact on CCM.

NOTE: All type is 113A, sizes indicated.

30.5 Surface drainage legend.

SURFACE DRAINAGE LEGEND

14pt. Caps

12pt. Caps

SYMBOL	DESCRIPTION
	[1]Canal/Channelized Stream/Irrigation Canal/Drainage Ditch <= 4.5 meters
	[2]Stream, Gap Width <= 4.5 meters
	[3]Stream/Canal, Gap Width > 4.5 - 18 meters
	Stream/Canal, Gap Width >18 meters
	Drainage Channel Point of Change Marker
covered drainage	Covered Drainage
W	Open Water (Coastal Waters, Large Rivers, Lakes, Ponds and Reservoirs)

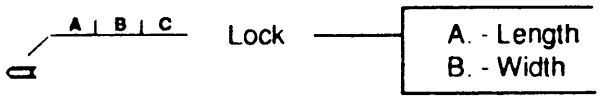
10pt. C/l

226144421	Sample Format Code (See Coding Table below)
	Off Route Fords
	Float Bridge/Raft Site
A | B | C | D	Dam >= 5 meters high
	Dam < 5 meters high

A. - Length
B. - Width at Crest
C. - Height
D. - Construction Material
- C - Concrete
- E - Earthwork
- S - Stone
- U - Unknown

NOTE: All type is 113A, sizes indicated.

30.5 Surface drainage legend (Continued).



[1,2] Unless otherwise designated, all canals, channelized streams, irrigation canals, drainage ditches and streams with gap widths of less than or equal to 4.5 meters are considered minor drainage features and will be assigned the following Digital Format Codes: _____ for canals, etc. and _____ for streams.

10pt. C/1

[3] Unless otherwise designated all streams with gap widths greater than 4.5 meters and less than or equal to 18 meters will be assigned the following Digital Format Code: _____.

NOTE: For location of Swamps, Marshes, and Wetlands (land subject to inundation) refer to Vegetation Overlay.

(The following notes are examples only; all notes, including the the standard codes stated above, must be individually tailored for each project area)

All overlays in this Tactical Terrain Analysis Data Base TTADB are produced for conditions expected to exist on a normal dry day during the summer season.

Discharge and velocity of both the Nisqually River and Muck Creek vary seasonally. High water period: Dec. - Feb., low water period: July - Oct. Portions of Muck Creek may dry up during summer months.

NOTE: All type is 113A, sizes indicated

30.5 Surface drainage legend (Continued).

SURFACE DRAINAGE CODING TABLE

12pt. Caps

DIGIT	CATEGORY DESCRIPTION	CODE
1st	Type :	
	No Data	0
	Stream Channel (Intermittent or Ephemeral)	1
	Stream (Perennial)	2
	Stream (Subject to Tidal Fluctuations)	3
	Canal/Channelized Stream/Irrigation Canal/Drainage Ditch	4
	Stream (Braided)	5
	Stream (Gorge)	6
2nd	Military Gap Width Bank to Bank (m):	
	No Data	0
	<= 4.5	1
	> 4.5 - 18	2
	> 18 - 50	3
	> 50 - 100	4
	> 100 - 142	5
	> 142	6
3rd	Bottom Material:	
	No Data	0
	Clay and Silt	1
	Silty Sands	2
	Sand and Gravel	3
	Gravel and Cobble	4
	Rocks and Boulders	5
	Bedrock	6
	Paved	7
4th	*Height, Right Bank (m):	
	No Data	0
	<= 0.5	1
	> 0.5 - 1.0	2
	> 1.0 - 5.0	3
	> 5.0	4

10pt. C/1

NOTE: All type is 113A, sizes indicated.

30.5 Surface drainage legend (Continued).

CODING TABLE (Continued)

5th	*Height, Left Bank (m):	
	No Data	0
	<= 0.5	1
	> 0.5 - 1.0	2
	> 1.0 - 5.0	3
	> 5.0	4
6th	Slope, Right Bank (%):	
	No Data	0
	<= 30	1
	> 30 - 45	2
	> 45 - 60	3
	> 60	4
7th	Slope, Left Bank (%):	
	No Data	0
	<= 30	1
	> 30 - 45	2
	> 45 - 60	3
	> 60	4
8th	Water Velocity, Average (m/second):	
	No Data	0
	<= 1.5	1
	> 1.5	2
9th	Water Depth, Average (m):	
	No Data	0
	<= 0.8	1
	> 0.8 - 1.6	2
	> 1.6 - 2.4	3
	> 2.4	4

10pt. C/l

* Underlined bank height codes indicate dense vegetation (thick brush or closely spaced trees able to prohibit vehicle movement) along bank for greater than 50% of stream segment.

NOTES: Category descriptions in Coding Table are ranked, from 1 through 9, depending on relative accuracy and availability of data. 10pt. C/l

Bank heights and slopes are read facing downstream.

NOTE: All type is 113A, sizes indicated

30.6 Transportation legend.

TRANSPORTATION LEGEND

14pt. Caps

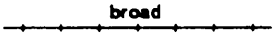
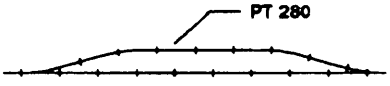
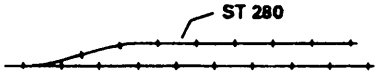
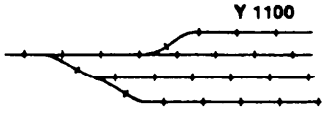
SYMBOL	GENERAL TRANSPORTATION FEATURES (May be used with roads, railroads, airfields, or other general transportation features)	12pt. Caps 10pt. C/l
UC	Feature Under Construction	
ferry	Ferry	
	Overhead Drop	10pt. C/l
	Side Drop	

SYMBOL	ROADS	12pt. Caps
	All weather, dual highway	
	All weather, hard surface	
	All weather, loose surface	
	Fair weather, loose surface	
	Track	10pt. C/l
6.0 7.5	Road Width (meters) Road Width Change Marker	
A	Constriction (width in meters) A. - Width (meters)	
	Steep Grade, > 7%	

NOTE: All type is 113A, sizes indicated.

30.6 Transportation legend (Continued).

SYMBOL	ROADS (Continued)	
	Sharp Curve (radius < 30 meters)	
	On Route Ford	10 pt. C/L

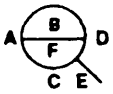
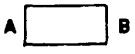
SYMBOL	RAILROADS	12pt. Caps
	Single track, normal gauge	
	Multiple track, normal gauge	
	Narrow gauge	
	Broad gauge	
	Electrified line	
	Dismantled Railroad	
	Passing track (>= 280 meters)	
	Siding (>= 280 meters)	10pt. C/l
	Yard (total track length in meters)	

NOTE*: Normal gauge for this map sheet is 1.435m (4ft. 8 1/2 in.)
Narrow gauge is 0.762m (2ft. 6in.)

*Example only, tailor for each project.

NOTE : All type is 113A, sizes indicated.

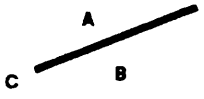
30.6 Transportation legend (Continued).

SYMBOL	BRIDGE DATA	12pt. Caps
═══	Bridge	
	Road Bridge Information Holder A. - Overhead Clearance (meters) R = Restricted U = Unlimited B. - Military Load Classification for one-way wheeled traffic C. - Width of Roadway (meters) D. - Overall Bridge Length (meters) E. - Bridge Bypass Potential within a 2 kilometer distance: E = Easy D = Difficult I = Impossible F. - Bridge Number (See Bridge Information Table)	10pt. C/l
	Railroad Bridge Information Holder A. - Overhead Clearance (meters) U = Unlimited R = Restricted B. - Overall Bridge Length (meters)	

SYMBOL	TUNNEL DATA	12pt. Caps
)::::::(	Tunnel	
	Tunnel Information Holder A. - Height clearance (meters) B. - Width clearance (meters) C. - Length (meters)	10pt. C/l

NOTE : All type is 113A, sizes indicated.

30.6 Transportation legend (Continued).

SYMBOL	AIRFIELD/AIRPORT RUNWAY DATA	12pt. Caps
	Line denotes orientation A. - Length (meters) B. - Width (meters) C. - P = Paved U = Unpaved Operational unless labeled	10pt. C/1

NOTE: All type is 113A, sizes indicated.

30.7 Obstacles legend.

OBSTACLES LEGEND

14pt. Caps

SYMBOL	DESCRIPTION
	Road/Railroad Cut
	Road/Railroad Fill
	Escarpment
	Depression
	Fence/Wall
	Hedgerow
	Embankment
	Moat
pipeline	Pipeline (Above ground)
pipeline	Pipeline Gap/Earth Filled Crossing Point
	Volcanic Dike (Wall like)
	Kanat
	Dragon's Teeth
	Shelterbelt/Windbreak

12pt. Caps

10pt. C/l

NOTE: Linear obstacles shown are > 1.5 meters high, > 250 meters in length, and > 60 percent slope. Refer to the Surface Drainage Overlay for potential hydrologic obstacles.

NOTE: All type is 113A, sizes indicated.

APPENDIX E

GENERAL GUIDE TO VEGETATION ROUGHNESS FACTORS

10. SCOPE

10.1 Scope. This appendix provides a general guide to the vegetation roughness factors (VRF) normally associated with each vegetation type. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. GUIDE TO VEGETATION ROUGHNESS FACTORS

30.1 Use of guide to vegetation roughness factors appendix. If ground truth collateral data exists indicating a different value would be more appropiate, this value will be used instead of the estimated VRF table value.

30.2 Estimated vegetation roughness factor table.

VEGETATION TYPE	ESTIMATED VRF	POSSIBLE CAUSES FOR VARIATION
A1	.70 - .90	f(type of crop, cultivation practices, type and depth of plowing, crop rotation, etc.)
A2	.30 - .60	f(type of crop, height and density of dikes)
A3	.00 - .60	f(type of crop, density and height of terraces)
A4	.40 - .70	f(% of cleared/forested area)
A5	.50 - .70	f(canopy closure of woodlots, type of crop)
A6	.70 - .90	f(canopy closure of trees, type of crop)
A7	.30 - .80	f(type of crop, depth, spacing, and density of ditches)
B1	.70 - .90	f(density, height, spacing)
B2	.50 - .90	f(density, height, spacing)
G1	.80 - .90	f(species, height)
G2	.60 - .70	f(density, height)
H	.30 - .80	f(method and % of removal)
IC	.10 - .70	f(species, branching fern, aerial rooting, density, % understory, etc.)
ID	.10 - .70	f(same as above)
IE	.10 - .70	f(same as above)
IM	.00 - .50	f(same as above)
IN	.10 - .70	f(same as above)
J	.20 - .90	f(species, height, density)
L	.40 - .60	f(species, management practices)
M	.30 - .60	f(density,height)
N	1.00	No vegetation, no effect
TH	.00 - 1.00	f(species, seasonality, height, and density)
TB	.00 - .80	f(species, seasonality, height, and density)

30.2 Estimated vegetation roughness factor table. (Continued)

VEGETATION TYPE	ESTIMATED VRF	POSSIBLE CAUSES FOR VARIATION
TA	.80 - 1.00	f(species)
W	0.00	f(open water)
X	NE	Built-up Area (Not Evaluated)
C,D,E,F	.40 - .80	f(species, branching fern, % underbrush, age, fallen trees, stumps,etc.)

NOTE: f( ) is defined as "function of (.....) "

APPENDIX F

TYPE SPECIMENS

10. SCOPE

10.1 Scope. This appendix provides samples of the TTADB type styles. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TYPE SPECIMENS

30.1 Type specimens.

UNIVERS MEDIUM

(113A) (UM)

5PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz 12345678
6PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz123456789
7PT ABCDEFGHIJKLMNOPQRSTUVWabcdefghijklmnopqrstuvwxyz123456
8PT.ABCDEFGHIJKLMNOPQRSTUabcdefghijklmnopqrstuvw123456
9PT.ABCDEFGHIJKLMNOPQRSTabcdefghijklmnopqs123456
10PT.ABCDEFGHIJKLMNOPabcdefghijklmnopq12345
12PT.ABCDEFGHIJKLMNabcdefghijk123456
14PT.ABCDEFGHIJKabcdefghijk12345
16PT.ABCDEFGabcdefghijkl1234
18PT.ABCDEFabcdefghij1234
24PT.ABCabcd12345
30PT.ABCab1234
36PT.ABab123
42ABabc123
48ABab123
72Aa12

UNIVERS LIGHT

(114A) (UL)

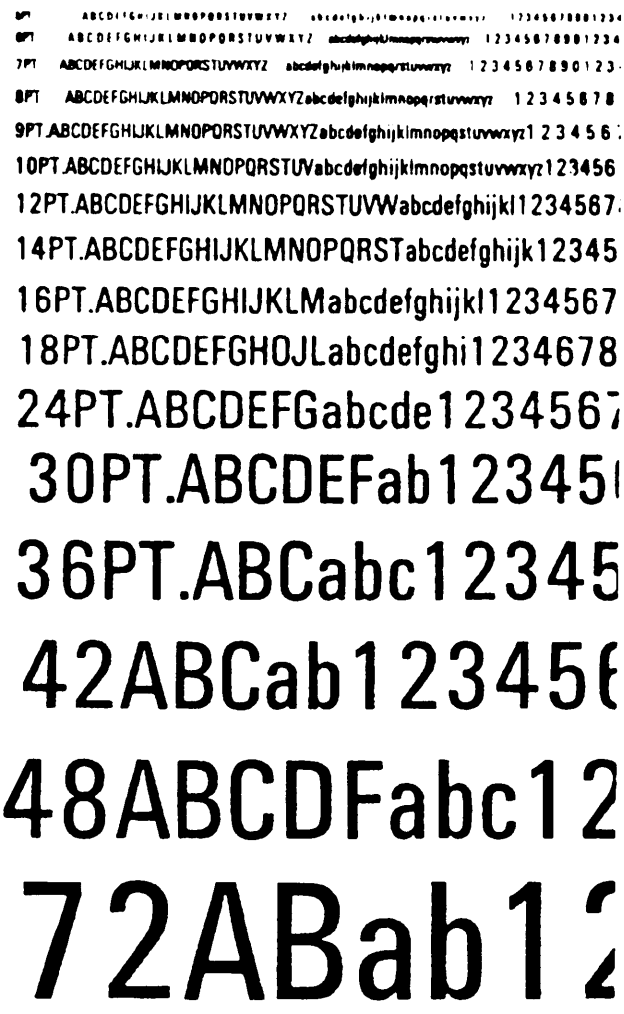
5PT ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 12345678
6PT ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 123456789
7PT ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz123456
8PT ABCDEFGHIJKLMNOPQRSTUVWabcdefghijklmnopqrstuvw1234567
9PT ABCDEFGHIJKLMNOPQRSTUVabcdefghijklmnopqst123456
10PT ABCDEFGHIJKLMNOPQRabcdefghijklmnopqs12345
12PT ABCDEFGHIJKLMNOabcdefghijkl1234567
14PT.ABCDEFGHIJKLabcdefghijk123456
16PT.ABCDEFGHabcdefghijkl12345
18PT.ABCDEFabcdefghijk1234
24PT.ABCDabcd123456
30PT.ABCab12345
36PT.ABab1234
42ABabc123
48ABab123
72Aa12

APPENDIX F

30.1 Type specimens. (Continued)

UNIVERS MEDIUM CONDENSED

(117A) (UMC)



UNIVERS BOLD CONDENSED

(118A) (UBC)

APPENDIX G

TYPE TEMPLATE FOR TERRAIN ANALYSIS
AREA FEATURES

10. SCOPE

10.1 Scope. This appendix provides a general guide to the type sizes to be used for coding or otherwise identifying the areal feature polygons on the various TTADB thematic overlays. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. GUIDE TO TYPE SIZES

30.1 Use of the type template. Where the type specifications permit a range of type sizes based on the areal limits of a feature's polygon, the type template shown on the next page will be used as a guide to assure uniformity of selections. When space or odd shape prohits use of a prescibed size, or the size indicated by the template will obviously distort the relative importance of a feature, a more appropriate size is to be selected.

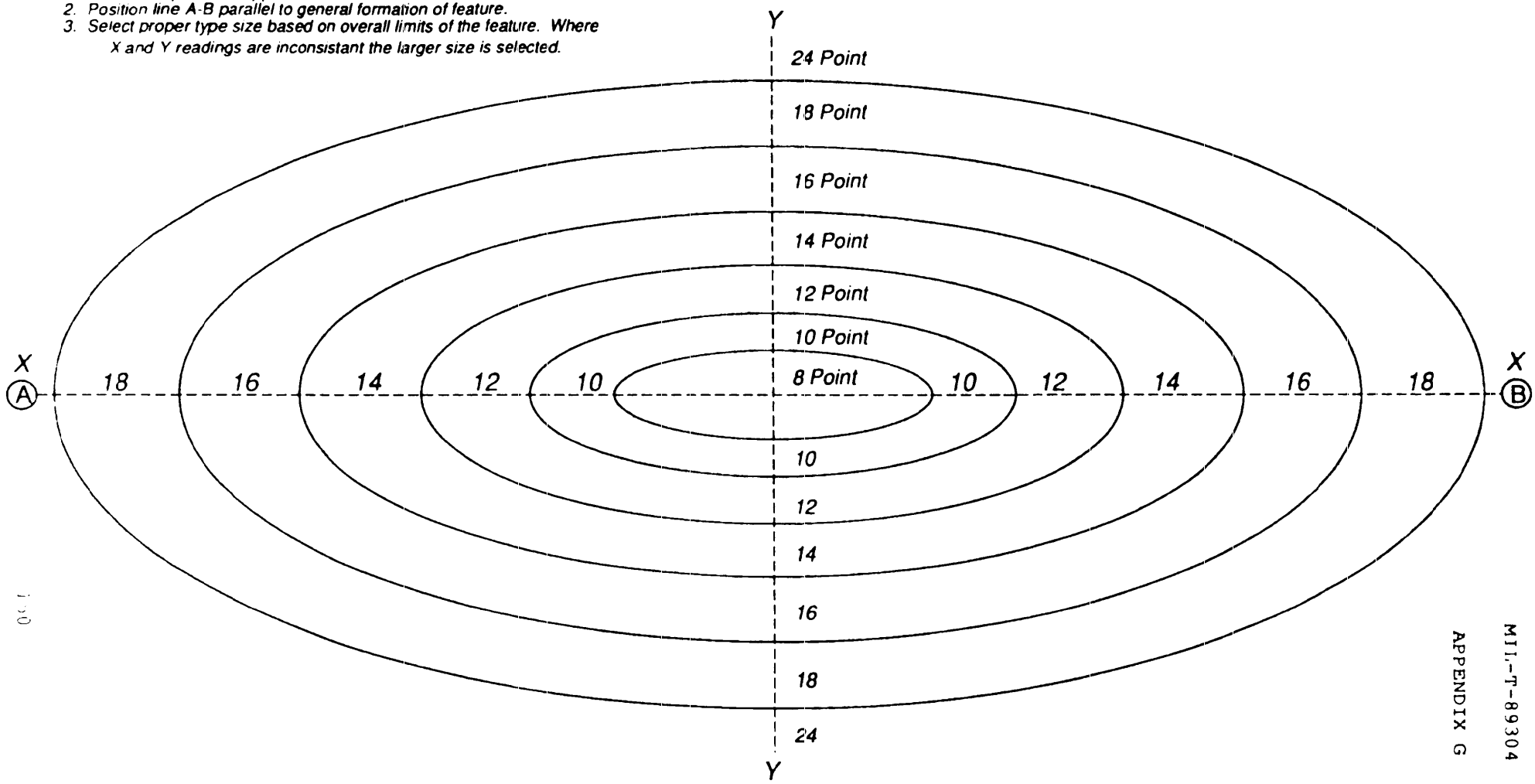
30.2 Type template. See next page.

TYPE TEMPLATE FOR TERRAIN ANALYSIS

AREA FEATURES

Instructions:

1. *Center templet over approximate center of feature.*
2. *Position line A-B parallel to general formation of feature.*
3. *Select proper type size based on overall limits of the feature. Where X and Y readings are inconsistant the larger size is selected.*



APPENDIX H

CONCEALMENT-AERIAL DETECTION (C-AD) TABLE

10. SCOPE

10.1 Scope. This appendix provides a general guide to the general concealment-aerial detection possibilities from overhead observation normally associated with the canopy closure of each vegetation type. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. GENERAL GUIDE TO CONCEALMENT-AERIAL DETECTION

30.1 Use of concealment-aerial detection table. If ground truth collateral data exists indicating a different value would be more appropiate, this value will be used instead of the indicated table value.

30.2 Concealment-aerial detection table.

Vegetation Overlay Unit	Vegetation Type	Canopy Closure (%)	C-AD (Summer) (%)	C-AD Map Unit (Summer)	C-AD (Winter) (%)	C-AD Map Unit (Winter)
A1-A3	Agriculture (dry, wet, terraced)	-	75-100	4	75-100	4
A4	Shifting Cultivation	(1)50-75	25-50	2	25-50	2
A5	Agric. w/Scattered Woodlots	(2)25-50	50-75	3	75-100	4
A6	Agric. w/Scattered Trees/Rows	(2)05-25	75-90	4	75-100	4
A7	Agriculture (ditch irrigation)	-	75-100	4	75-100	4
B1 & B2	Brushland/Scrub	-	75-100	4	75-100	4
C11-C19	Coniferous Forest	0-25	75-100	4	75-100	4
C21-C29	" "	25-50	50-75	3	50-75	3
C31-C39	" "	50-75	25-50	2	25-5	2
C41-C49	" "	75-100	0-25	1	0-25	1
D11-D19	Deciduous Forest	0-25	75-100	4	75-100	4
D21-D29	" "	25-50	50-75	3	75-100	4
D31-D39	" "	50-75	25-50	2	75-100	4
D41-D49	" "	75-100	0-25	1	75-100	4
E11-E19	Mixed Forest	0-25	75-100	4	75-100	4
E21-E29	" "	25-50	50-75	3	75-100	4
E31-E39	" "	50-75	25-50	2	50-75	3
E41-E49	" "	75-100	0-25	1	50-75	3
F11-F19	Orchard/Plantation	(1) 00-25	75-100	4	75-100	4
F21-F29	" "	25-50	50-75	3	50-75	3

30.2 Concealment-aerial detection table. (CONT'D)

Vegetation Overlay Unit	Vegetation Type	Canopy Closure (%)	C-AD (Summer) (%)	C-AD Map Unit (Summer)	C-AD (Winter) (%)	C-AD Map Unit (Winter)
F31-F39	" "	50-75	25-50	2	25-50	2
F41-F49	" "	75-100	0-25	1	0-25	1
G1	Grassland, Meadows, Pasture	-	75-100	4	75-100	4
G2	Grassland w/Scattered Trees	0-25	75-100	4	75-100	4
H	Forest Clearings (burns,cuts,etc)	-	75-100	4	75-100	4
IC	Evergreen/Coniferous Swamp	(See Coniferous Forest (C11-C49) Categories)				
ID	Deciduous Swamp	(See Deciduous Forest (D11-D49) Categories)				
IE	Mixed Swamp	(See Mixed Forest (E11-E49) Categories)				
IM	Mangrove Swamp	(1)	(See Coniferous Forest (C11-C49) Categories)			
IN	Nipa Swamp	(1)	(See Coniferous Forest (C11-C49) Categories)			
J	Marsh/Bog (peat)	-	75-100	4	75-100	4
L	Vineyard/Hops	-	75-100	4	75-100	4
M	Bamboo/Wild Cane	(2) 75-100	0-25	2	75-100	4
N	Bare Ground	-	75-100	4	75-100	4
TA,TB,TH	Tundra Areas	-	75-100	4	75-100	4
W	Common Open Water	-	75-100	4	75-100	4
X	Common Built-up Area	(3) 25-50	50-75	3	50-75	3

(1) Assumed to be coniferous/evergreen trees or plants that retain most of their leaves year-round; if there is a loss of leaves on a seasonal basis, that category of vegetation will fall into map unit code 4 for the winter product.

(2) Assumed to be deciduous trees or plants that lose most of their leaves for at least one season.

(3) If percent of roof cover is not given, default value is assumed to be 25-50%.

NOTE: This table can be modified to reflect variations in vegetation conditions as they exist in a particular area of the world and to include categories not listed above.

APPENDIX I

PREVIOUSLY USED AND REQUESTED MISCELLANEOUS FEATURES

10. SCOPE

10.1 Scope. This appendix defines and specifies the symbology to be used for most of the miscellaneous and/or unique features which have been occasionally added to the various thematic overlays since the first edition TTADB specifications (PS/3JB/010) were published in January 1982. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance, on an as needed basis, **and only as directed by supplemental project instructions**.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix

30. TTADB MISCELLANEOUS FEATURES

30.1 Miscellaneous features that are now part of the TTADB specification. Current features in this specification which started as miscellaneous and/or unique features on previous terrain analysis projects include: (1) Both types of dropgates, (2) Float bridge/raft sites, (3) Dragon's teeth, (4) Above ground pipelines and pipeline crossing points, (5) Volcanic dikes, (6) Kanats, (7) Naturally and culturally dissected areas, etc.

30.2 Miscellaneous feature definitions.

30.2.1 **Slope categories** (Symbol 103, labeled "A" to "H" as listed below). In order to meet the requirement for helicopter landing areas to have a slope no greater than 15% and to take advantage of the ability of newer vehicles coming into the military inventory to approach a practical field limit climbability of 60%, some previous projects have changed the slope categories listed in 3.14.2.1.1 to those shown below. For older vehicles the practical field limits remain 30% for wheeled vehicles and 45% for tracked vehicles.

Map Unit Code	Slope (%) Category
A	0 - 3
B	> 3 - 10
C	>10 - 15
D	>15 - 20
E	>20 - 30
F	>30 - 45
G	>45 - 60
H	>60

30.2.2 Vegetation features (Symbol 103, labeled "TH" to "IN" as listed below).

a. Tundra regions, which comprise almost 20 percent of the northern most land areas on the Earth, with their ecologically fragile environments are another unique situation. These are normally flat to undulating treeless plains found in arctic and subarctic regions, and characterized by frozen to moist topsoils over perma-frost. These areas may have low grass tufts with ice cores (pingos),

which vary in continuity and uniformity. Since ground saturation inhibits movement during the summer thaws, these areas are often only suitable for movement during the winter months when the top soil layers are completely frozen. Tundra environments are generally described as being one of three types:

(1) **Herbaceous Tundra** (code TH) - Tundra regions characterized by non-woody vegetation associations of mosses, lichens, sedges, and grasses often forming an almost continuous ground cover. There can be minor occurrences of low growing (less than .5m) woody shrubs and thickets.

(2) **Brush (shrub) Tundra** (code TB) - Tundra area in which the vegetation is dominated by scattered to dense woody shrubs and thickets, usually in association with mosses, sedges, and grasses.

(3) **Alpine Tundra** (code TA) - In dry, or alpine tundra, vegetation is generally sparse, growing closely matted to the ground. In higher elevations, alpine tundra vegetation may be scattered among barren rocks and rock outcrops. Vegetation found in dry tundra commonly includes mountain-avens, lichens, and mosses and may include other herbs, grasses and sedges growing on bare rocks, sand, or gravel. If less than 10 percent ground cover this category will be coded bare ground (Code N).

b. Two types of treed agricultural areas can be locally important in some areas:

(1) **Agriculture with Scattered Woodlots** (code A5) - Cropland is the predominant vegetation with 25 to 50 percent of the area covered with scattered small woodlots, none of which individually meet the minimum size requirements for portrayal separately. Woodlots are intermixed with cropland throughout the area. Large areas of open cropland next to A5 areas shall be portrayed as A1, A2, A3, or A7 agricultural areas.

(2) **Agriculture with Scattered Trees/Rows of Trees** (code A6) - Cropland is the predominant vegetation with fields and/or roads bordered by rows of trees or scattered individual and/or small clumps of trees covering 5 to 25 percent of the area. Rows of trees and/or individual trees are dispersed (intermixed with cropland) throughout the area. Large areas of open cropland next to A6 areas will be portrayed as A1, A2, A3, or A7 agricultural areas.

c. **Ditch Irrigation** (code A7) - Cropland in areas irrigated by water channeled in small ditches or furrows which are usually 10 to 20cm deep and 100 to 400m long with centers spaced 75 to 150cm apart. This type of cropland can occur in all climatic regions and at times can appear to be very similar to wet crops.

d. **Nipa Swamp** (code IN) - A separate swamp class which consists of a dense growth of stemless palms found in tropical and semi-tropical tidal and brackish waters. It usually occurs farther inland than mangrove and forms strips in channels through which the tidal waters flow.

e. Modification of undergrowth categories - The presence and/or density of undergrowth is given in four, instead of two, categories.

(1) A solid line under a wooded vegetation map unit indicates dense undergrowth (greater than 50% ground cover).

(2) A dashed underline indicates a sparse to medium (0 to 50 percent) ground coverage) undergrowth.

(3) A dotted underline indicates there is no undergrowth - either there is not enough light reaching the forest floor or some man or animal activity such as gleaning or grazing, has removed the undergrowth.

(4) No underline indicates that the presence and/or density of undergrowth is unknown.

(5) The undergrowth underline symbols shall be straight line versions of symbol 104 (_____), symbol 105(_ _ _ _), and symbol 106 (.....).

30.2.3 Surface materials features (Symbol 103, labeled "CM or RF" as listed below).

a. **Inorganic clay and silt combinations** (code CM) - Inorganic clay and silt combinations are borderline soils which exhibit the properties of both the CL and ML soil groups. These soils plot in a zone on the plasticity chart (Figure 400-1) where no clear break between silty and clayey soils exists. These soils have plasticity index values between 4 and 7, and a liquid limit below 29.

b. **Rock Field** (code RF) - Areas with surface covering of rocks ranging in size upward from cobbles (larger than 7.62cm or 3 inches in diameter) to 50 percent or less bedrock outcrop (code RK). These areas are sometimes also referred to as boulder fields. Neither the type of rocks or bedrock is identified.

c. Frozen (attribute of soils, shown with a dash/dot map unit code underline, Symbol 107)).

(1) Frozen soils have temperatures below freezing, and the soil moisture in the pore spaces is frozen and the soil components are bound together into a solid mass.

(2) Permafrost is the condition of perennially frozen ground which underlies about 20 percent of the Earth's land surface, mostly in the northern Arctic tundra regions. It is usually found in level to nearly level lowland areas, but can also be found in upland depressions and regions of sloping surfaces with soils that have very poor internal drainage.

(3) Note that the top layers of permafrost soils, such as expanses of Arctic tundra, are subject to thaw and on sloping ground to solifluction (soil creep downhill due to constant freezing and thawing) during the summer. Therefore, if possible, they should be avoided during that season.

30.2.4 Surface drainage features.

a. **Intermittent lakes** (Symbol 501).

(1) An inland body of standing water that occurs only [illegible]

standing water and being dry on some periodic, usually yearly, cycle. These are sometimes referred to as ephemeral or temporary lakes. Salt evaporators are man-made intermittent lakes.

(2) As illustrated in Figure 65, intermittent lakes can be features unto themselves but they are also found on the outer edges of permanent lakes.

FIGURE 65. Intermittent lakes.

(3) When dry, most intermittent lakes will support full or at least partial military operations across them.

(4) Intermittent lakes no matter what their size, are only shown on the Surface Drainage Overlay. However, they must meet a minimum size limitation of >= 2 square millimeters (5000 square meters ground area) with a minimum width equal to or greater than 1mm (50 m ground distance).

(5) Intermittent lakes are coded with the capital letters "IW" and are depicted with a dashed line (Symbol 501).

b. **Anastomosing Stream** (First digit is 7).

(1) Areas where perennial streams contain numerous interlacing channels with stabilized islands. As illustrated in Figure 66, these are depicted by showing the minimum size islands (1mm x 2mm) within the full stream channel.

(2) If necessary, and room is available, a special note giving other descriptive information is added to the legend. For example, "Average gap widths between islands in anastomosing streams range from 4.5m to 19m".

(3) The gap width is taken as the bank to bank width across the entire normal limits of the stream's flood channel, not just across the flood channels between the islands. The entire gap width is coded with the nine digit code.

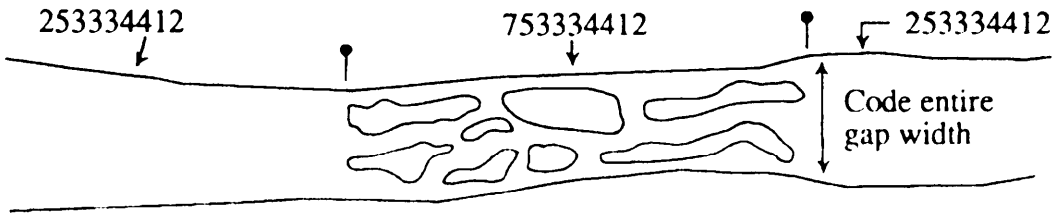


FIGURE 66. Example of anastomosing stream channel.

c. **Wash/Wadi/Arroyo** (First digit is 8 - Symbol 507).

(1) A steep sided, usually dry, watercourse, channel, or gulch with a nearly flat floored flood plain or gully of an ephemeral or intermittent stream, generally found only in arid areas. This type of feature is subject to flash flooding after brief but heavy rainfall over even a small area having steep slopes, usually mountainous uplands. In the uplands, these are usually steep-sided, broad and rather shallow features cut through unconsolidated material with bouldery, gravelly, stony or sandy beds. Washes/Wadis/Arroyos are often situated at the bottom of a steep valley, canyon, or ravine but most commonly occur as flood formed features incised into a flat or nearly flat plained desert area.

(2) Most washes/wadis are fed by a series of intermittent streams, which are not shown inside a wash/wadi. This type of feature usually ends on either an outwash plain, an area of enmeshing channels, or a perennial stream will develop at the end of the wash/wadi, as illustrated in Figure 67.

(3) The banks of the wash/wadi at the normal limit of flood stage (normal flood channel) is used as the line of measurement for determining wash/wadi width, delineating the location of permanent streams within the feature, and stream coding. Perennial streams within the wash areas are shown and coded, as appropriate.

(4) The wash/wadi banks greater than or equal to 5 meters high will also be picked up on the Obstacles Overlay as escarpments. The linework between the Drainage Overlay showing the washes/wadis and the Obstacles Overlay indicating the escarpments should be exact (line for line).

(5) The channels within these areas are often numerous and braided. An oversized dashed outline will be used to show the areal extent of the wash/wadi with the addition of the capital letters "WS" inside the dashed outline, as depicted in Figure 67.

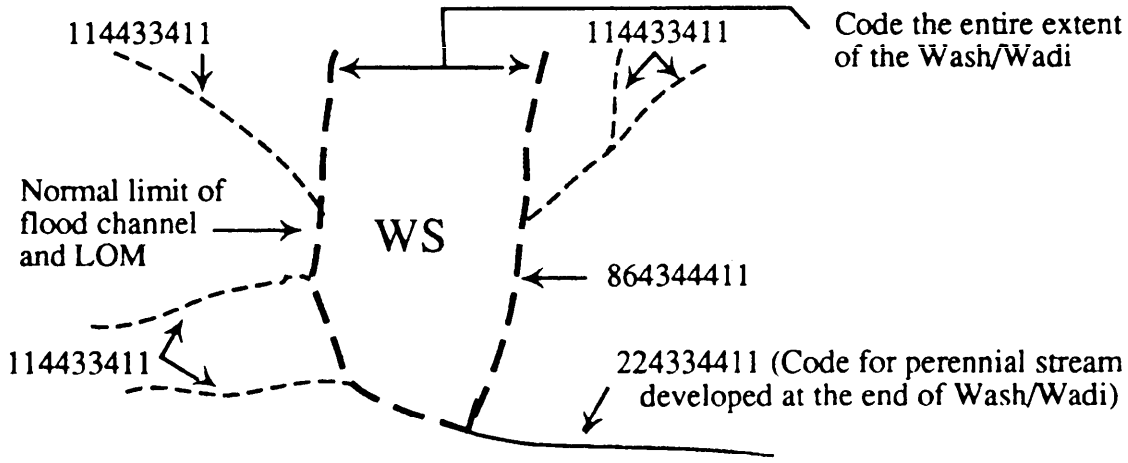


FIGURE 67. Portrayal of wash/wadi/arroyos.

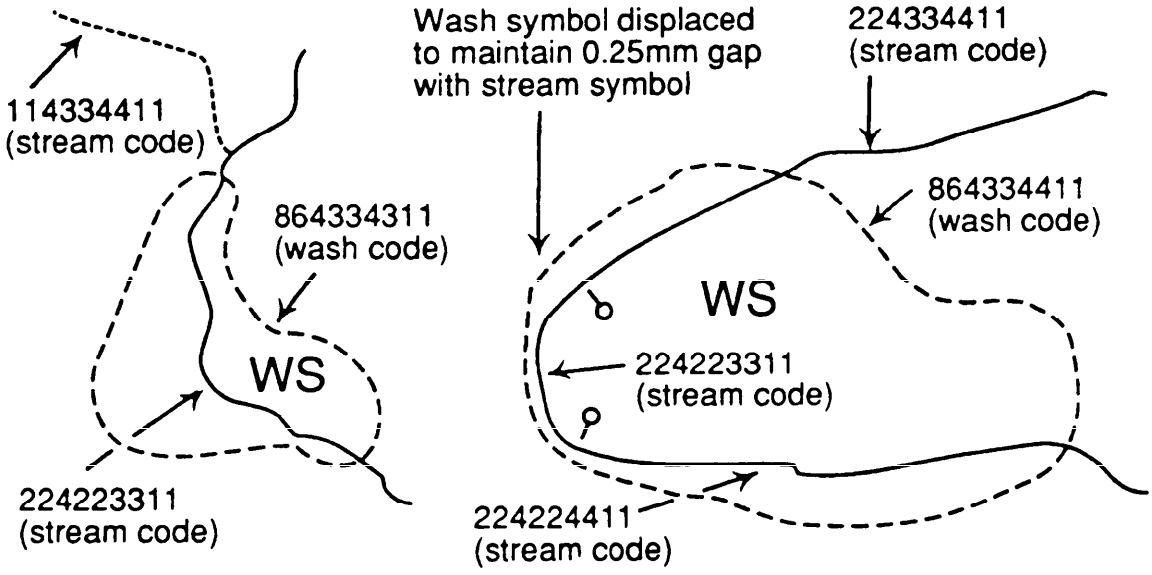
(6) Perennial streams within washes/wadis.

(a) Only permanent perennial streams within washes/wadis are shown and coded.

(b) The line representing the stream should pass through the gaps in the wash/wadi symbol (Symbol 507). Leader lines may pass through or be broken.

(c) If wash/wadi boundary and perennial stream segment are coincident, the wash/wadi symbol is displaced to the outside to leave a gap of 0.25mm between the symbols.

(d) Examples of perennial streams in wash/wadi areas are shown in Figure 68.



a. Stream does not touch side of wash/wadi.

b. Stream touches side of wash/wadi.

FIGURE 68. Perennial streams in wash/wadi/arroyos.

(7) Rock outcrops within washes/wadis

(a) In some arid areas, permanent rock outcrops (similar to islands) occur within washes/wadis. Figure 69 is an example of the portrayal of these features.

(b) Washes/wadis with rock outcrops (islands) should be treated similarly as anastomosing streams. They are to be coded across their entire outside extent, as though the outcrops (islands) were not there. The rock outcrops (islands) inside the areal extent of the washes/wadis will be outlined and the capital letters "WS" placed in the wash/wadi.

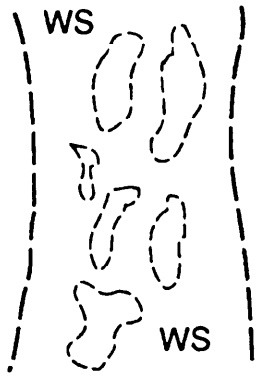


FIGURE 69. Rock outcrops within wash/wadi/arroyos.

d. **Enmeshing Channels** (Symbol 508).

(1) The large area of enmeshing channels is used when individual drainage features can not be coded separately. An area of enmeshing channels is generally an area of considerable size, wider than 20mm (1000m ground distance) where the interlacing channels of one or more washes/wadis/arroyos fan out over a large area in a pattern of tangled intertwining channels. The whole area is subject to flash flooding either during the local rainy season or after regional precipitation in the upland portions of the watershed. See Figure 70.

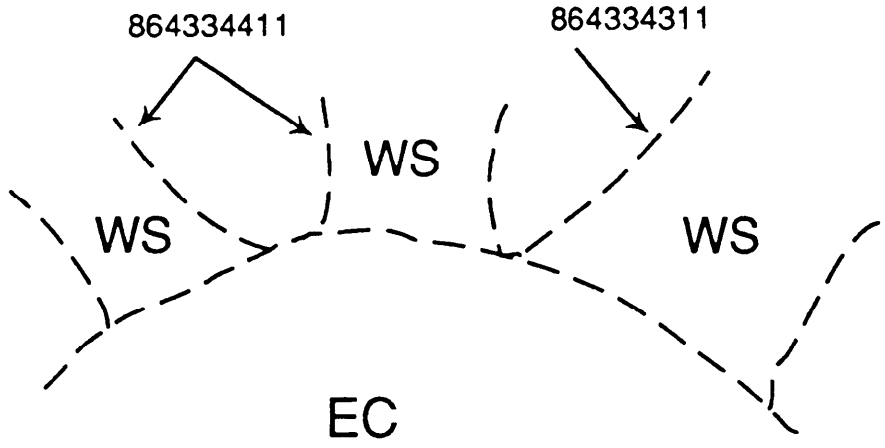


FIGURE 70. Wash/wadi converging into a large enmeshing channel.

(2) The area of enmeshing channels will not be coded except with the capitol letters "EC" inside the area delineated with an oversized dashed line (Symbol 508).

(3) Permanent perennial streams and rock outcrops within areas of enmeshing channels will be treated in the same way as they are in washes/wadis/arroyos. See Appendix I, 30.2.3c.(7).

(4) If the boundaries of an enmeshing channel area are formed by steep sided cliffs (over 5m in height) they will also be depicted on the Obstacles Overlay as escarpments.

e. **Aqueducts** (Symbols 518 and 519).

(1) Open or Covered, Artificial or Natural, Conduits - These conduits carry large quantities of flowing water for either domestic or industrial water supply purposes. These features are usually constructed of earth, brick, stone, steel, or concrete and may be tunnelled through rock, elevated, built-up on the ground, at ground level, or below ground or in tunnels.

(a) Open channel streams, canals, ditches, and covered drainage are shown and coded on the Surface Drainage Overlay as already described.

(b) Flumes, pipelines, penstocks, kanats, and similar closed or covered water supply features, whether elevated, on, or below ground level, are not shown on the Surface Drainage Overlay. For arid areas, these will be covered in the 1:250,000 scale Water Resources Overlay (s) produced by the Engineer Topographic Laboratories at Fort Belvoir.

(2) Artificial bridge-like structure used for carrying an elevated stream, canal, ditch, or water supply conduit (aqueduct) over another stream, canal, transportation feature, depression, or valley.

(a) On the Surface Drainage Overlay, bridge-like aqueducts will be shown only if they occur along open drainage features already described in that section. Most of these will be located along large navigable streams and canals.

(b) If less than or equal to 2mm (100m ground distance) long, the aqueduct will be treated as a point feature.

(c) If greater than 2mm (100m ground distance) long, the aqueduct will be shown to scale. Point of change symbols will be used to indicate where the elevated section of the waterway begins and ends.

(d) Elevated aqueducts are not coded with the standard nine-digit surface drainage code. They will be depicted using the capital letters "EA" (Elevated Aqueduct) (Symbol 518), with an aqueduct information holder symbol (Symbol 519) indicating in order the overall length, waterway width, and waterway depth. (See Figure 71).

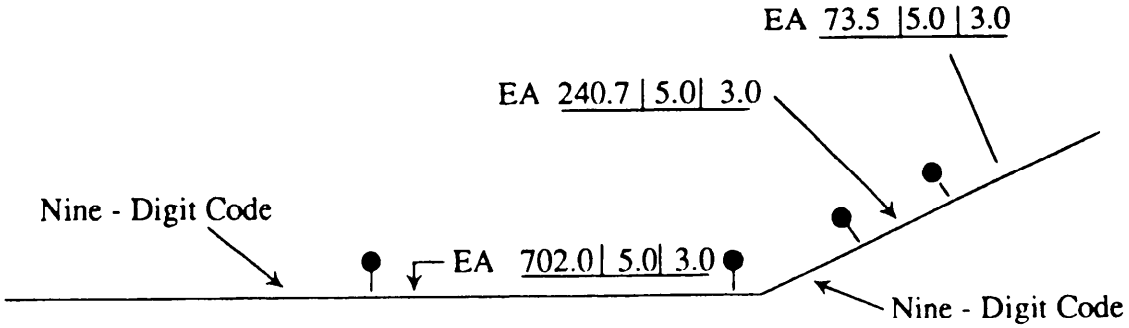


FIGURE 71. Coding elevated aqueducts.

f. **Tidal Flats** (Symbol 509).

(1) A tidal flat is a flat or nearly flat, barren or slightly marshy area. It is generally of considerable size, being formed through deposition caused by the alternate rise and fall of the tide and consists mostly of unconsolidated silts, clays and/or sands. Tidal flats of silts and clays are usually wet and do not make a good surface for military vehicle movement, however, at low tide, the sandy tidal flats, depending on their soil moisture content, might make an excellent surface for military vehicle movement, before the next high tide.

(2) Tidal flats will be coded with the capital letters "TF" and an oversized dashed line (Symbol 509) delineating the area.

g. **Weirs** (Symbol 515).

(1) Weir - A small artificial barrier across a stream used to raise the water level or to divert its flow into a desired channel. Normally the water will either overflow the barrier or flow through a notch designed to regulate and/or measure the stream discharge or water flow. All weirs are depicted with a weir symbol (Symbol 515).

(2) Where a road or railroad bridge crosses over a Sluice Gate (Figure 72), the sluice gate will be shown as a weir on the Surface Drainage Overlay (Symbol 515), while the road bridge will be picked up on the Transportation Overlay.

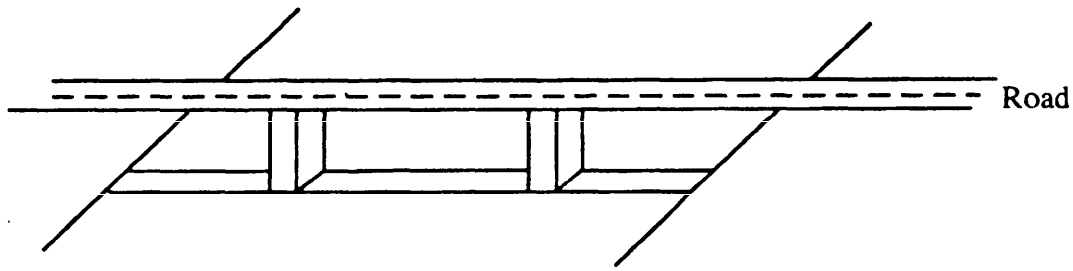


FIGURE 72. Road crossing over a weir (sluice gate).

h. **Features Under Construction** (Symbol 521, which is same as Symbol 613)

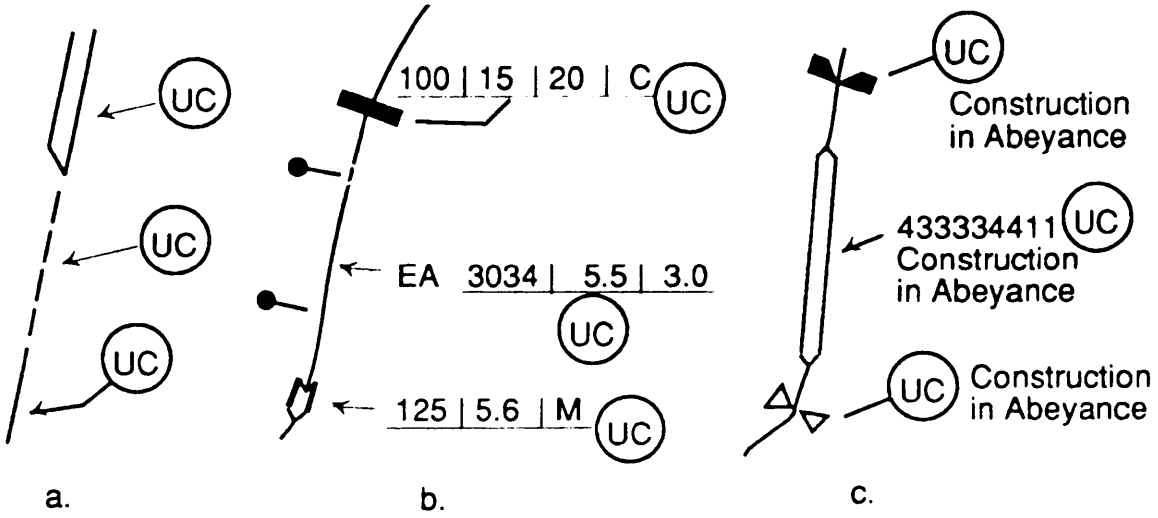
(1) Features designated as under construction are those where construction is actually underway. The under construction symbol is used to indicate which point, linear, or areal feature or segment is being built or rebuilt. Point of change symbols (Symbol 102) are used to show the extent or length of linear or areal features under construction.

(2) The under construction symbol can be used in a number of ways:

(a) All unknown features which are under construction along a stream, canal, ditch, or other drainage way are symbolized with a circled "UC" and leader line pointing to the center of the point, linear segment, or areal feature. See Figure 73.a. Unknown (neither identified or classified) linear segments will be shown with the canal, etc., gap less than or equal to 4.5 meters symbol (Symbol 503). Unknown areal segments and features will be shown with the stream or canal gap width greater than 18 meters symbol (Symbol 505).

(b) All under construction features which can be identified and classified will utilize their proper symbol with a circled "UC" being applied to the right of the feature symbol or data information holder. See Figure 73.b.

(c) If construction was started, but now has been indefinitely suspended, the words "Construction in Abeyance" will be added to the right of the circled "UC" symbol. See Figure 73.c.



a. Use of "UC" symbol for unclassified features under construction.
b. Use of "UC" symbol for classified features under construction.
c. Use of "UC" symbol for suspended construction of features.

FIGURE 73. Use of under construction symbol.

i. **Representative Pattern Area** (Symbol 520).

(1) This is a fourth method of portraying drainage in cartographically crowded areas where the sheer density and extent of the features prevents the coding of small segments.

(2) A representative pattern area may be used in these situations where the Surface Drainage features are spaced less than 5mm (250m ground distance) apart over an areal extent of at least 20 square millimeters (50,000 square meters ground area) with a minimum width greater than or equal to 1mm (50m ground distance). These areas should also be covered by surface roughness numbers, descriptors, and factors on the Surface Materials Overlay. Two possible surface roughness descriptors are:

(a) Slightly to moderately spaced canals (streams, ditches, or whatever the feature) - 100 to 250 meters (2 - 5mm map distance) apart.

(b) Numerous canals (streams, ditches, or whatever the feature) - less than 100 meters (2mm map distance) apart.

10. SCOPE

(3) When Surface Drainage features are spaced greater than 5mm (250 meters ground distance) apart, all drainage features will be delineated and coded.

(4) When determining which drains to included as part of the representative, the primary drains will be depicted first. If much wider than the other drains to be included in the representative sample, the primary drains running through the area should be individually delineated and coded.

(5) When a representative pattern area is used to portray or code the situation, a dashed line around the area with a short descriptive note will be shown on the thematic overlay (Symbol 520). The descriptive note will cite the type of drainage being represented, the range of code values being represented, and other pertinent information (such as the spacing between canals or ditches), as illustrated in Figure 74.

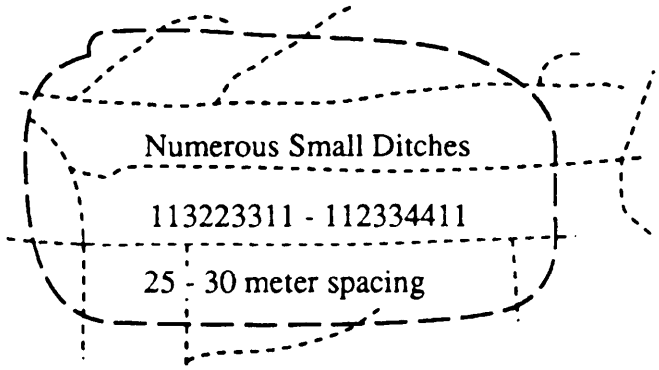


FIGURE 74. Use of representative pattern area with descriptive note in an area of dense drainage ditches.

j. Additional bottom materials category (3rd digit, stream format code):

Bottom Material	Third Digit Code
h. Peat and/or highly organic material	8

k. Additional dam construction material categories:

Dam Information Holder Code	Construction Material
R	Stone (Rock) and Earth
W	Wood
O	Other

l. Lock construction material - The lock information holder is extended to include a letter "C" compartment, which is used to show the construction materials of locks in the following categories:

Lock Information Holder Code	Construction Material
U	Unknown
C	Concrete
O	Other
M	Masonry (Stone/Brick)
R	Stone (Rock) and Earth
S	Steel
W	Wood

30.2.5 Transportation features.

a. **Trails** (Symbol 605) - A natural traveled way not wide enough to accommodate wheeled or track vehicles. Trails are created by the historical passage of animals or humans over a natural travel way.

(1) Trails intersecting with higher road classifications do not affect road segments, individual road segments are not formed.

(2) Road widths are not given for trails; however, a note next to the trail symbol in the legend will give the average trail width for the project area.

b. **Restricted (Narrower) Passage** (Symbol 608)

(1) Any point along a road segment where the road width narrows by 2.5 meters ground distance (approximately one lane) or more from the rest of the road, but is still greater than or equal to 4 meters wide, is considered to be a restricted (narrower) passage. This may occur at any point along a road segment.

(a) If the restricted passage is less than 2mm (100m ground distance) in length, it is depicted with the triangles of the associated restricted passage symbol (Symbol 608) opposing each other.

(b) If the restricted passage is between 2mm (100m ground distance) and less than 10mm (500m ground distance), it is depicted with the triangles of the restricted passage symbol (Symbol 608) offset to the beginning and end of the section from each other.

(2) Width measurement is indicated (preferred) adjacent to the lower right side of lowest triangle and parallel to the tangent of the southern neatline

(3) Narrower passages are not shown on tracks or trails.

c. **Abandoned railroad** (Symbol 619) - An abandoned railroad is a track system which is no longer in use but whose tracks and bridges are still in place. The word "abandoned" is placed above and parallel to the original track symbol.

d. **Canals** (Symbol 624)

(1) On the Transportation Overlay(s) the depiction of canals is limited to navigable waterways less than or equal to 3.2mm (160m ground distance) wide, which are defined as any stretch of a natural watercourse or maintained canal

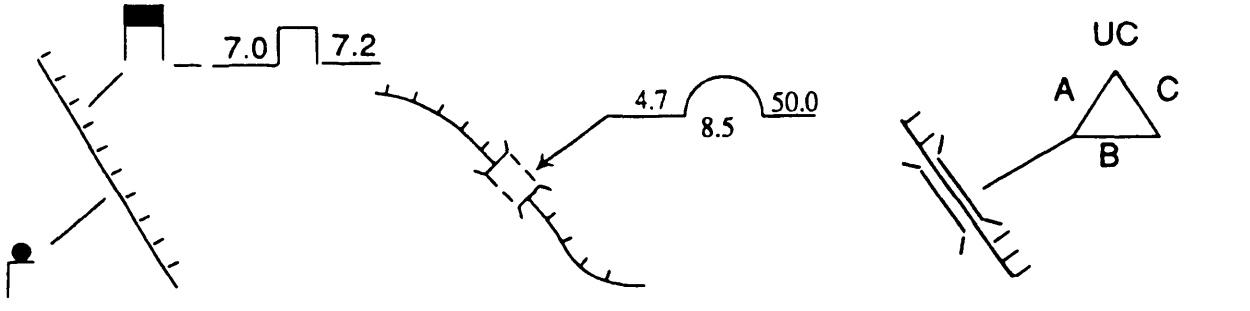
or channelized stream available to and used by commercial water craft. Canals or inland waterways greater than 3.2m (160m ground distance) are treated as common open water areas and are not shown on this thematic overlay(s).

(2) All facilities must be wide enough and deep enough to allow the passage of boats and/or ships over its entire length. Thus these can be country specific depending on the size and draft of the boats and barges using them. These canals form a linkage of man-made waterways, streams, and open water areas over which personnel and goods can be moved by boat or ship between built-up areas, transportation transfer points, military facilities, and between seas and oceans.

(3) A navigable canal should have a minimum length of at least 20mm (1000m ground distance) before it is shown on the Transportation Overlay. The mainline of the canal symbol (Symbol 624) will be shown following the centerline of its associated drainage feature.

(4) As the channel characteristics (nine-digit code) and some of the support facilities (i.e., locks and dams) are fully covered on the Surface Drainage Overlay, they do not need to be duplicated on the Transportation Overlay. However, in order to maintain the integrity of the bridging relationship, where these canals or navigable waterways pass over bridge-like aqueducts they will be shown using the regular bridge symbol (Symbol 626).

(5) Associated transportation features, such as dropgates and tunnels, use the same depiction rules for canals as for roads and railroads. Figure 75 illustrates the use of some these features along canals.



a. Dropgates b. Tunnel c. Bridge Under Construction In Congested Area

FIGURE 75. Associated features along canals.

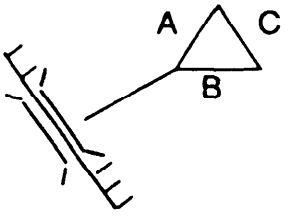
e. **Canal Bridges** (Symbol 626) - All bridges use same symbol.

(1) **Canal (Aqueduct) Bridge Information Holder** (Symbol 629). The symbol indicating the attribute placement for Overhead Clearance, Overall Bridge Length, and Waterway Width is illustrated in Figure 76.

(a) For canal bridges, the normal height of the water surface is defined as the transport surface for measuring overhead clearance. The value corresponds to "A" in the Canal Bridge Information Holder - add to Transportation Legend (See Appendix I, 30.4.5a.(5)(b)).

(b) For canal bridges the overall bridge length is the length of the bridge's water surface supporting material with end plates between the points of intersection with the abutments. The value corresponds to "B" in the Canal Bridge Information Holder section of the Transportation Legend (30.4.5a(5)(b)).

(c) Waterway Width - The traveled way width of a canal bridge is measured horizontally at the normal height of water surface and perpendicular to the bridge length centerline from the inside of one wall to the inside of the other wall. The value corresponds to "C" in the Transportation Legend (Canal Bridge Information Holder), see Appendix I, 30.4.5a(5)(b).



A. Overhead Clearance
B. Overall Bridge Length
C. Waterway Width

FIGURE 76. Attribute placement in canal bridge information holder.

f. Viaducts and/or **Elevated Roads, Railroads, and Canals** (Symbol 625).

(1) Viaducts and/or elevated roads, railroads, and canals are bridge-like structures consisting of a long series of usually short, evenly spaced, bridge spans which lift the route over water, congested portions of urban areas or carry it over areas otherwise unsuitable for placement on the ground, such as tidal marshes, steeply sloping deep valleys, areas subject to flooding, areas which would otherwise require extensive engineering effort and subbase preparation, or other obstructions. Support abutments or piers may range in height above the ground and carry the route in a generally horizontal position. The main construction materials are concrete, masonry blocks, or steel.

(2) Only the arch (open and closed spandrel), beam, girder, and slab bridge types, over 20mm (1000m ground distance), crossing mainly land features or acting as causeways will be considered for treatment as elevated transportation routes. All others are considered regular bridges.

(3) Extended elevated transportation routes will often change bridge types or span lengths where they cross over a stream (river) or transportation feature. At these points, the changed span or spans will be shown as a regular bridge abutting the elevated structure at both ends. If a bridge is not shown where another transportation route passes under an elevated structure, an overhead obstruction symbol (Symbol 637, Appendix I, 30.2.5h.) and a gap of 0.5mm (0.02in) on each side of the elevated structure symbol will be used on the underpassing transportation feature. See Figure 77.

(4) Elevated roads, railroads, and canals shall be depicted as linear features.

(5) The elevated road (ER), elevated railroad (ERR) or elevated canal (EC) identification letters (Symbol 625) should be centered between the point of change symbols (Symbol 102) which indicate the beginning and end of the elevated

s trish. sizes indicated. NOTE: All type

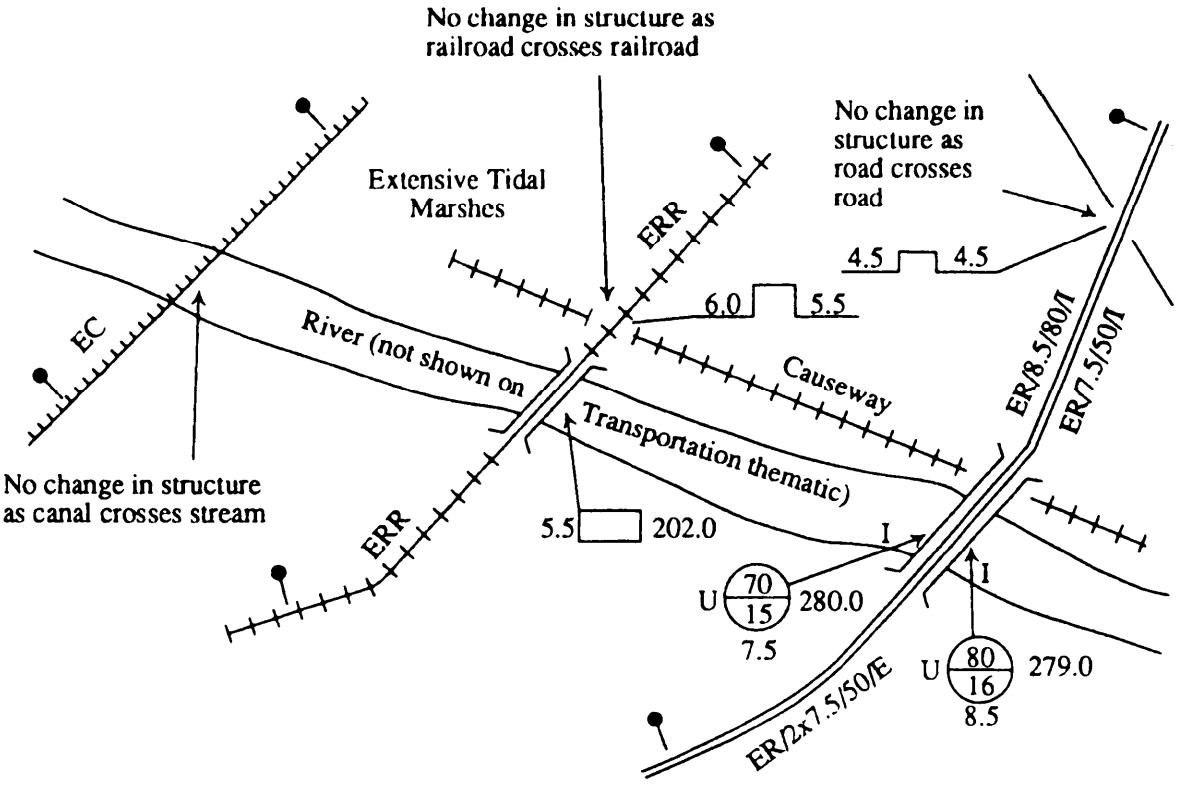


FIGURE 77. Elevated transportation routes.

structure at non-intersection points and placed parallel with the transportation route. If space does not allow for adjacent labeling of the elevated structure, leader lines will be used to point from the label to the location of the particular feature and will be placed horizontal to the southern neatline.

(6) For elevated roads, an elevated road information holder (Symbol 639) is also used. Thus the complete label not only includes the structure identification letters, but also the roadway width, Military Load Classification, and bypass condition as illustrated in Figure 78.

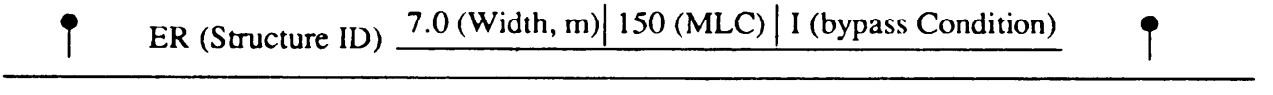


FIGURE 78. Elevated road structure identification.

(7) In most cases, the military load classification (MLC) for elevated roads will be identical for the entire structure. If the MLC varies along the elevated road structure, the minimum MLC of any section is used for classifying the entire structure.

g. **Culverts** (Symbol 630).

(1) A culvert is defined as a transverse drainage structure which serves as a water conduit permitting a stream, canal or ditch to pass under a road, railroad, or canal. This conduit may be constructed of metal and/or concrete and

may be circular, semicircular or rectangular in cross-section. The culvert inlet barrel may project from the roadway fill or it may be mitered to the embankment slope. Culvert inlets sometimes have wingwalls, apron slabs, or headwalls. Two types of culverts, as shown in Figure 79 and Figure 80, have been portrayed on the Transportation Overlay(s).

(2) Earth Back-filled Culverts

(a) Earth back-filled culverts are composed of one or more conduits (concrete pipe, oval concrete pipe, corrugated metal pipe, etc.) that are covered with compacted soil. These culverts are usually associated with soil overburden existing between the culvert structure and the road or railroad traveled way. With this structure the soil is the load-bearing material. The width of this structure can be of any dimension, no structure width limitations are imposed.

(b) Earth back-filled culverts (concrete pipe, oval concrete pipe, corrugated metal pipe, arch pipe, etc.) less than 2.5 meters wide are not classified or mapped. Culverts 2.5 meters or greater are classified and identified with the letter "c" (Symbol 630).

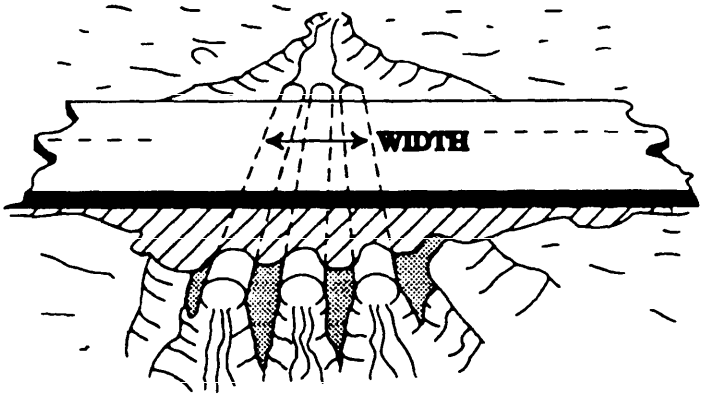
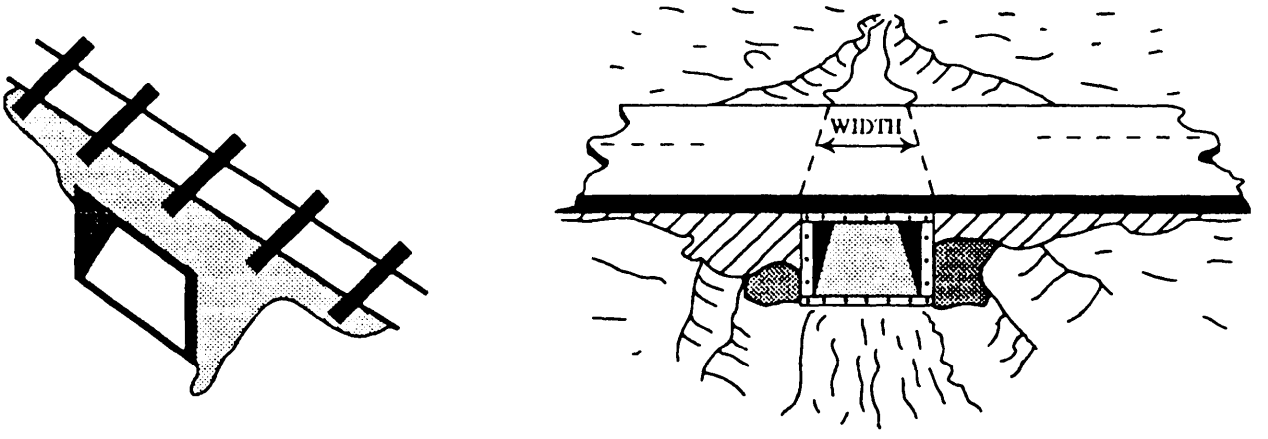


FIGURE 79. Earth back-filled culvert.

(3) Box Culvert:

(a) Box culverts are composed of one or more conduits with a square or rectangular cross section. Normally box culverts are constructed of concrete or concrete with reinforced metal. This structure may or may not be associated with soil back-filling. If not back-filled, the top member of this structure normally serves as the transport support surface or base and is the primary load-bearing member.

(b) Box culverts less than 2.5 meters in width are not classified or mapped. Box culverts with width's 2.5 meters to 5 meters are classified and tagged as culverts using the letter "c" (Symbol 630). Box culverts with no overburden and greater than 5 meters in width are classified and treated on the Transportation Overlay(s) as bridges. Box culverts having overburden and width's greater than 5 meters: **will not** be classified as bridges but will be identified and tagged as culverts using the letter "c" (Symbol 630).



a. Earth Back-Filled b. Load Bearing

FIGURE 80. Box culverts.

h. **Snowsheds/Rocksheds/Galleries** (Symbols 633 and 634).

(1) Snowsheds, rocksheds, and galleries are structures built along transportation routes, (roads, railroads, and canals) for the purpose of preventing blockage by snowslides and/or rockslides respectively. Often the roof adjoins the side of a cliff or cut and steeply slopes over the transportation route to divert snow or rock slides to lower elevations on the other side. These structures are usually found in mountainous areas and are generally built of wood. Often they will have the downhill side open for light and ventilation of exhaust gasses.

(2) Snowsheds, rocksheds, and galleries that can be identified on the imagery or derived from current collateral sources may be included on the thematic overlay(s). Those less than 2mm (100m ground distance) in length will be treated as point features and depicted with a minimum size snowshed/rockshed/gallery symbol (Symbol 633); whereas those greater than or equal to 2mm (100m ground distance) in length will be treated as linear features and plotted "to scale" in length (and width, if needed).

(3) No distinction is made for the type of transportation route passing through a snowshed, rockshed, or gallery. The data displayed in the snowshed/rockshed/gallery information holder (Symbol 634) is the same for three of these features. All associated attributes measured from the imagery will be shown to the nearest half meter (0.5m). If available, more precise measurements from field check (on-the-ground) data or collateral sources will be shown instead.

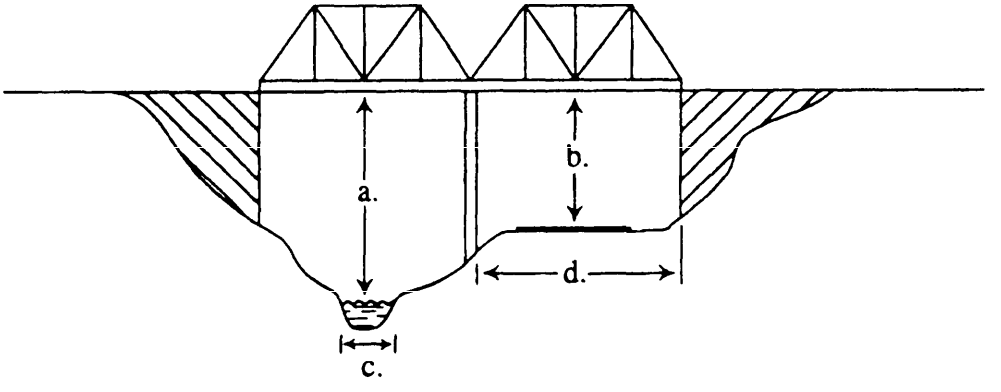
(4) The characteristics covered in the snowshed/rockshed/gallery information holders are symbolized as shown in Appendix I, 30.3.4, page 184, and if shown should be added to the Transportation Legend, Appendix D, 30.6, after the tunnel data section, as Snowshed/Rockshed/Gallery Data. They are assigned attribute measurement values or codes for the same items as tunnels (See 3.12.10.2): (1) Height or overhead clearance, (2) Width or horizontal clearance, and (3) Length.

(5) The snowshed/rockshed/gallery symbol suppresses the transportation route symbols where they are coincident, the transportation feature going

through the snowshed/rockshed/gallery is not shown, even if the data base holds them for feature continuity.

i. **Overhead Obstructions** (Symbol 637).

(1) An overhead obstruction is any height and/or horizontal obstacle through or under which a depicted road, railroad, or canal passes which is not already shown or attributed on the Transportation Overlay(s). Examples of places where overhead obstructions occur are where transportation features pass through town walls, towers, gate houses or archways in older urban areas; under walkways, water supply aqueducts or low overhead pipelines; under bridges where the underbridge clearance (given in the BIT) is to the lower stream level rather than the higher level transport surface (see Figure 81); under elevated transportation features and other such man-made or even natural obstructions and obstacles part of which overhangs the feature of interest and is of sufficient strength to constitute a height barrier if hit by underpassing vehicles. They are sometimes referred to as underpasses or mini-tunnels. Note that where the representative pattern bridges itself and there is more than a one meter difference between the underbridge clearance and the overhead clearance, two symbols will be needed, one for the bridge and one for the overhead obstruction.



a. Under Bridge Clearance.
b. Overhead Clearance for road.
c. Horizontal Clearance for stream.
d. Horizontal Clearance for road.

FIGURE 81. Measuring clearances under overhead obstructions.

(2) All overhead obstructions are considered to be point features, less than 2mm (100m ground distance) in overhead length above the affected transportation feature. If the overhead obstruction is greater than or equal to 2mm (100m ground distance) in length above the transportation feature of interest, it will be considered and treated as a tunnel. An example of the latter would be a railroad passing under a large building for a distance greater than 2mm (100m ground distance).

(3) Overhead obstructions that can be identified on the imagery or derived from current collateral or field check data may be included on the thematic overlay(s). The associated attributes measured from imagery will be shown in the overhead obstruction information holders to the nearest half meter (0.5m). If available, more precise measurements from field check (on-the ground) measurements or collateral sources will be shown instead.

NOTE: All type is trim, black underlined.

(4) There is no independent symbol for overhead obstructions, instead a leader line from the overhead obstruction information holder (Symbol 637) points to the location of the obstruction along the affected transportation feature. The attributes covered in the overhead obstruction information holders are symbolized as shown in Appendix I, 30.3.4, page 184, and if shown should be added to the Transportation Legend, General Transportation Features section, see Appendix I, 30.4.5a.(1).

(5) Overhead obstructions are assigned attribute measurement values or codes for (1) Horizontal clearance or width of opening and (2) Overhead clearance or height of opening.

(a) Horizontal clearance or width of opening - Horizontal clearance or width of opening is the minimum usable width of the opening through the obstruction measured above the transport surface horizontally from the inner side of one wall, guardrail, raised walkway, or abutment to the other. The measurement is made perpendicular to the transportation feature's length centerline as it passes under the obstruction. For transportation features passing under bridges this is usually the horizontal distance from the inside of one abutment to the other. The horizontal clearance value corresponds to "A" in the Transportation Legend (General Transportation Features, see Figure 82).

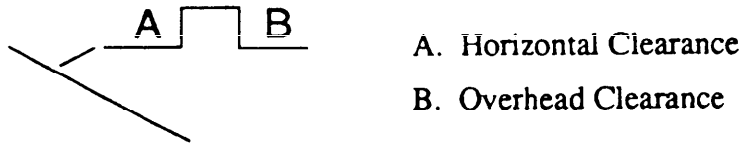


FIGURE 82. Attribute placement in overhead obstruction information holder.

(b) Overhead clearance or height of opening - Overhead clearance or height of opening is the minimum usable height of the opening through the obstruction between the top of the transport surface and the highest part of the obstruction ceiling. The overhead clearance value corresponds to "B" in the Transportation Legend (General Transportation Features, see Figure 82).

(c) Overhead dropgates are in effect a special form of overhead obstructions. Therefore, if both dropgates and overhead obstructions are being used, the overhead dropgate symbol shall be shown with an overhead obstruction information holder (Symbol 637). See Figure 83 for example uses along various types of transportation routes.

j. **Landing area** (Symbol 640) - Place used for landing aircraft where there is no clearly defined direction of approach and/or runway(s), the planes land in a big areal field (usually circular or rectangular in shape). This is rare, and is normally associated only with natural earth surface materials, such as grass, bare ground, etc. Like runways, 3.12.13.2, length and width are attributed.

k. Additional Bridge Attributes:

(1) Railroad and canal bridge numbers

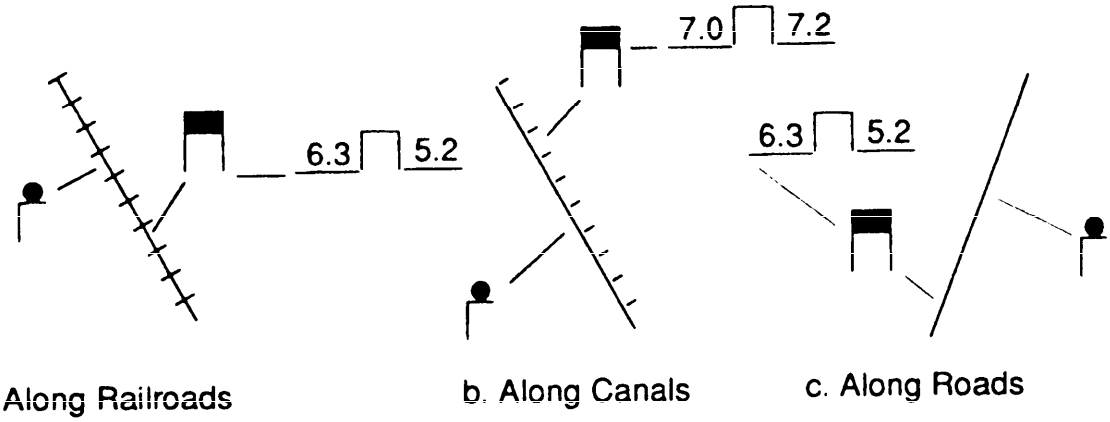


FIGURE 83. Depiction of dropgates.

(a) Railroad bridge numbers are assigned in the same way as road bridge numbers and begin their numbering, (1) at least 20 numbers higher than the last road bridge number, or (2) at 20, if there are no road bridges.

(b) Canal bridge numbers are also assigned in the same way and begin their numbering, (1) at least 20 numbers higher than the last railroad bridge number, or (2) 20 higher than last road bridge number, if there are no railroad bridges, or (3) at 20, if there are no railroad or road bridges.

(c) These bridge numbers will be placed inside their respective symbols and will constitute the letter "C" under Railroad Bridge Information Holders and the letter "D" under Canal Bridge Information Holders as shown in Figure 84.

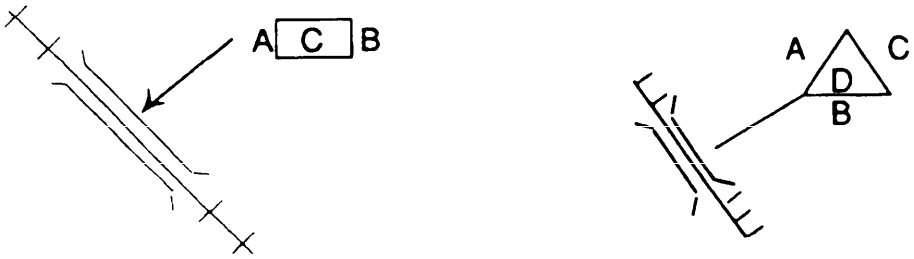


FIGURE 84. Railroad and canal bridge numbers.

(2) If there is an obstruction of unknown height on a bridge, the letter (R) for restricted clearance shall be used in the overhead obstruction position of the appropriate bridge type information holder.

(3) If the MLC is not known, but a civilian load classification is available, the latter will be shown in the BIT within parentheses.

(4) Horizontal clearance (HZC)

(a) The horizontal clearance is the overall usable width of a bridge measured 30cm (approximately 12 inches) above the traveled way surface. It is a measure of the width of a load which may be moved across or through a bridge.

(b) For road bridges, this measurement may be identical to the roadway width measurement if no other usable space is available on the bridge surface. However, this measurement would be different if the usable portion of the bridge included not only roadway width but also bridge pullovers, parking areas, curbs, and/or bridge shoulders.

(c) If there is no truss, girder, guardrail, or other obstruction to prevent the load from extending past the edges of the bridge the letter (U) for unlimited clearance is used. If there is an obstruction of unknown width the letter (R) for restricted clearance is used.

(5) Bridge architectural type (BAT) - The bridge architectural type is an indication of the size, shape, and construction of the structure, as well as an indication to possible restrictions on the size of the loads which may be moved over the bridge. The basic ten types of bridges recognized and their code letters are listed below: (See Figure 85.)

(a) Arch, Closed Spandrel (A)
(b) Arch, Open Spandrel (O)
(c) Beam (B)
(d) Cable Stayed (C)
(e) Cantilever (V)
(f) Floating (F)
(g) Girder (G)
(h) Slab (S)
(i) Suspension (P)
(j) Truss (T)
(k) Other (X)

(6) Bridge Movement (BMT) - The movement factor indicates characteristics of the bridge structure. (See Figure 86.) The types of movement and their code letters are listed below:

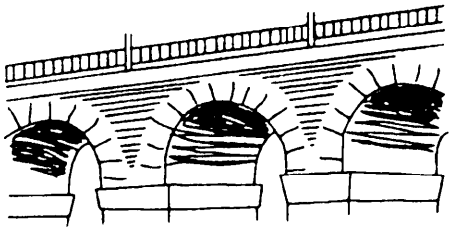
(a) Bascule (drawbridge) (B)
(b) Fixed (F)
(c) Lift (vertical) (T)
(d) Retractile (semipermanent, engineer moveable) (R)
(e) Swing (S)
(f) Other (X)

k. Additional Runway Non-operational Status Label - "Dismantled" - facilities and runway(s) taken apart.

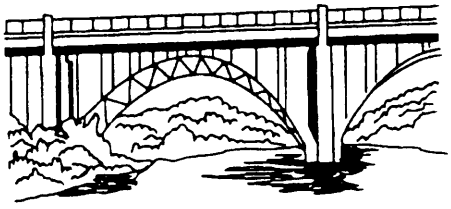
30.2.6 Obstacle features.

a. **Shelterbelt/Windbreak** (Symbol 705) - A long row or multiple rows of tall bushes or trees used as a natural snow fence to protect transportation features and/or agricultural areas from drifting snow and/or wind erosion - not a common treed fence line. The vegetation is so closely spaced that it prevents vehicles from leaving the roads or passing between them.

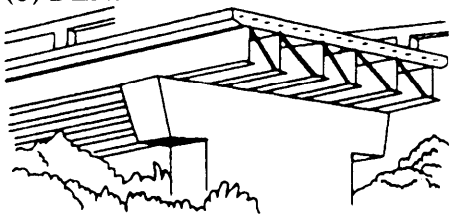
(a) ARCH (Closed Spandrel)



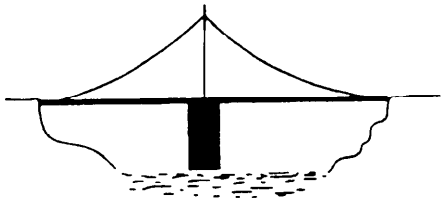
(b) ARCH (Open Spandrel)



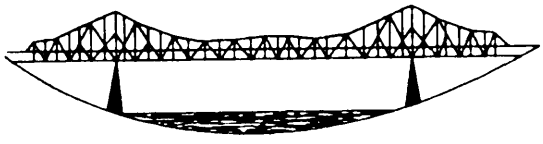
(c) BEAM



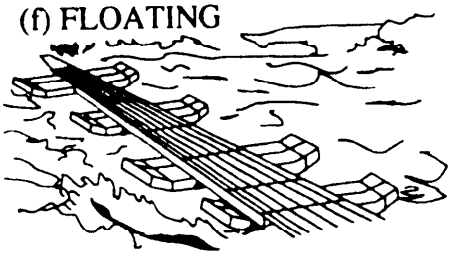
(d) CABLE STAYED



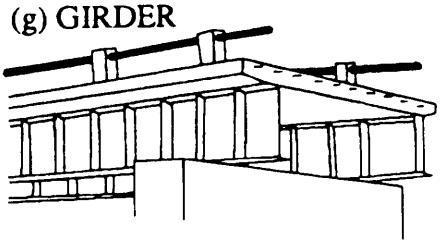
(e) CANTILEVER



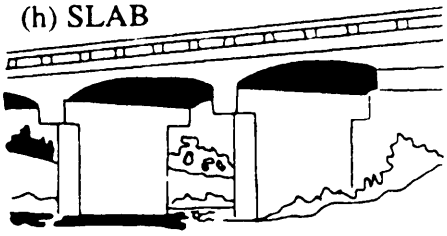
(f) FLOATING



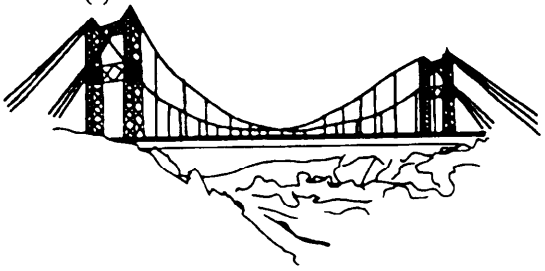
(g) GIRDER



(h) SLAB



(i) SUSPENSION



(j) TRUSS

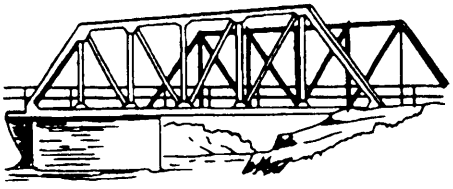


FIGURE 85. Examples of bridge structures.

c. Railroad

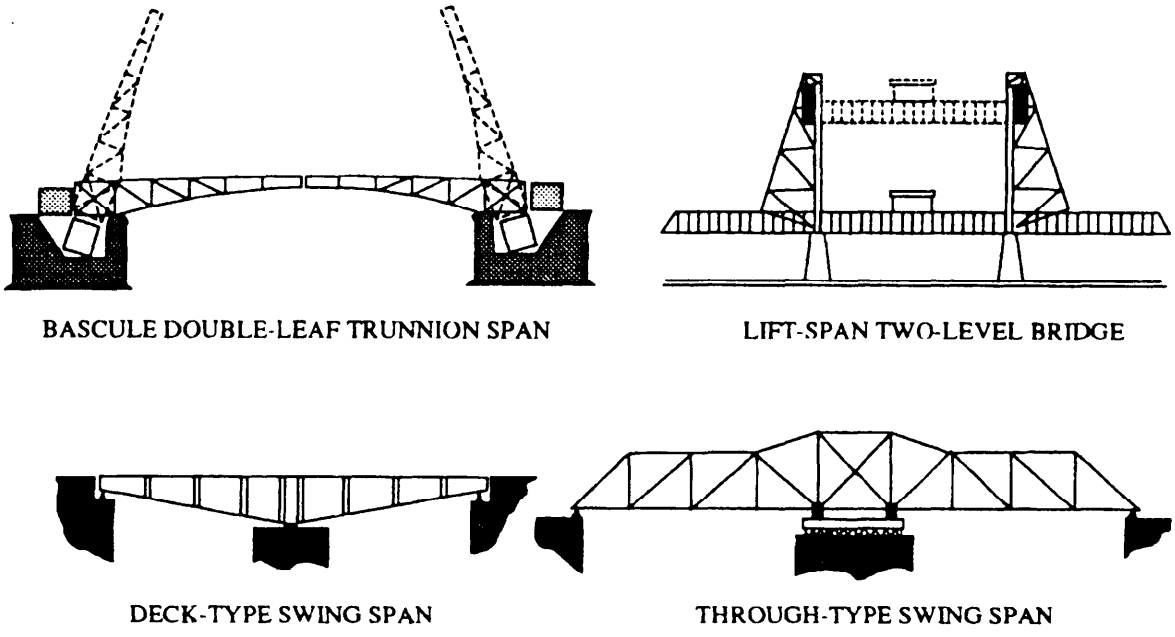
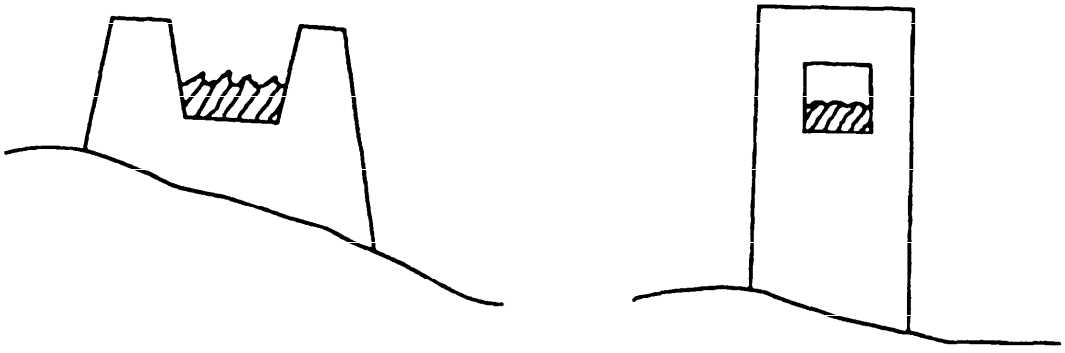


FIGURE 86. Examples of movable bridges.

b. **On-Ground Aqueducts** (Symbol 718) - Open or covered, man-made conduits for carrying large quantities of flowing water for either domestic or industrial water supply purposes which rest directly on the ground. They may be constructed of brick, stone, concrete, or have natural earth sides. For military ground movement they act as walls with an open or closed trench-like opening lengthwise down the middle. See Figure 87.



a. Open (Trench-like). b. Closed (Solid Wall-like).

FIGURE 87. On-ground aqueducts.

c. **Above Ground or Elevated Structures** (Symbol 719) - Structures, such as elevated aqueducts, railroad trestles, low bridges, etc., which are characterized by height and/or width clearances between supports that prohibit military vehicles from passing beneath or through them. In some structures the normal height and width clearances would permit passage under the structure, but the supporting members arrangement will still block passage, these are also shown as above ground or elevated structures.

d. **Wooded Gully** Symbol 721) - A narrow (<1mm map or 50m ground distance width), steep sided (>60 percent slopes), heavily vegetated (>75% canopy closure), dry gully or ditch. Its effect on cross-country movement is like that of a combination moat and shelterbelt; hence, its symbol is a mixture of their two symbols.

e. **Anti-Tank Ditch** (Symbol 713) - A man-made "V" shaped trench dug for the purpose of imposing an obstacle to armored vehicle cross-country movement in otherwise favorable areas. Their obstacle value is that they are too wide (>2.77m for the M-1 Abrams Tank) for armored vehicles to self bridge and that the angle of the "V" is less than the vehicle approach angle needed to climb out, if they did enter. They are generally found in open, broad, unbroken, expanses of plain, prairie, or steppe areas where they substitute for a sparse pattern of natural drains, but can be found anywhere, even across narrow mountain valleys.

f. **Impact Areas** (Symbol 714) - Mostly artillery target practice areas where there is a high probability of unexploded ordnance. If possible, movement through these areas is normally avoided.

g. **Minefield** (Symbol 715) - An area planted with explosive devices or charges in order to prevent movement through it. Only those areas known to be permanently mined will be shown.

h. **Kanat (Qanat, Karez**, etc.) (Symbol 710) - An underground water channel or conduit dug to conduct ground water by gravity, with closely spaced spoil piles from shafts or outlets which provide access for construction and maintenance; a horizontal well. Normally found in arid areas, where surface evaporation would be a problem, bringing water from alluvial gravels at the base of a mountain range under a desert to a built-up area in a lowland. To be shown, spoil piles must have less than 3.65 meters of natural, open ground surface between them.

i. Modification of Fence/Wall (Symbol 702) - The aggregation of fences and walls is divided into two parts where **fences** (Symbol 702) are given the old combined symbol and **walls** (Symbol 703) receive a new separate symbol with the type of wall labelled, if known. Definitions remain the same as given in 3.27.2.1c.

30.2.7 Urban areas. (Shown on combined Obstacles-Urban Areas Overlay)

a. **Common urban areas** (Symbol 103, labeled as per 30.2.7c. below).

(1) Common urban areas are defined as built-up places where the roads, area paving, and buildings cover approximately 30% or more of the available land area. Urban areas with less than 30% built-up ground cover (such as suburban residential areas) will still allow cross-country movement and will be considered non-common urban areas.

(2) Built-up areas are normally symbolized by using straight lines. However, it is acceptable to outline built-up areas with curved lines, if the boundary follows the edge of some rounded feature, such as open water, a river, a railroad, a canal, or town wall.

(3) The common urban areas on this overlay are common to and will also be depicted on the Surface Materials (Soils) and Vegetation Overlays. This

allows the common urban areas to be depicted with identical outlines (line for line) on all three overlays.

b. **Other (non-common) urban areas** (Symbol 103, labeled as per 30.2.7c. below).

(1) Non-common urban areas are defined as built-up places where the roads, area paving, and buildings cover approximately 5% to 30% of the available land area. The buildings are in close enough proximity to be considered a common unit, for example: an open village settlement, industrial park, rural prison, open college campus, or a scattered processing facility of several buildings within a common boundary.

(2) In rural areas with scattered residential dwellings and farm buildings, at least several buildings with some evidence of commonality (walkways, trails, common well, etc.) between several families must be clumped closely together in order to be considered an urban area. Individual or two family farms or homesteads are not to be considered in this category.

c. Classification and Coding of Urban Areas

(1) Within all urban areas on the thematic overlay, the following categories and attributes will be classified and coded. To be considered predominant, the man-made structures, paved areas, and transportation network must support 60% or more of the category being classified and coded.

(2) Predominant Land Use - Human use of urban or built-up land areas is divided into nine categories:

(a) **Residential** (Code R) - The majority of the area and its supporting features are devoted to the living accommodations (dwelling units) of human beings. These range from small single family huts to large high-rise apartment or condominium buildings. The area may be interspersed with small shopping centers, churches, schools and small fire, police, telecommunication and power stations, etc.

(b) **Recreational** (Code S) - Large sports complexes and other areas which are devoted to athletic events or recreational activities. An example is a fairground or a stadium area and their surrounding parking lots. Note that parks and other open space areas, even within built-up areas, which meet the minimum size specifications, will be shown and coded on the other overlays and will not be depicted on this thematic.

(c) **Institutional** (Code G) - Areas and complexes used for governmental, educational, religious, penal, research, care of the aged, and other administrative purposes. Note that medical facilities and hospitals are treated as a separate category.

(d) **Military** (Code A) - The cantonment or built-up areas of an armed forces base containing structures and facilities for the quartering and training of troops, base defense, depots, vehicle parks, and repair facilities that are exclusively military. This does not include the open space, maneuver areas and other non-built-up areas on a military base.

(e) **Transportation and Utilities** (Code T) - Large blocks of land used for transportation, utility and storage of bulk goods. For example: large public utility areas (water and sewage treatment plants, major power generation stations, etc.), large terminals, trans-shipment points, storage and repair facilities associated with the movement of goods and personnel by road, railroad, canal, airway, or pipeline. The linear segments of transportation features both within and without urban areas, even if parallel to each other, are not included on this thematic overlay.

(f) **Commercial** (Code C) - A concentrated area of retail and wholesale establishments, financial institutions, office buildings, hotels, garages, public buildings and other structures and facilities used primarily for the sale and exchange of goods and services.

(g) **Industrial** (Code I) - An area of individual plants and buildings with associated grounds, limited storage areas, and transportation facilities that are engaged in manufacturing activities. For example: these include heavy industries such as metal processing plants, rolling mills, fabrication yards, pulp and lumber mills, oil refineries, shipyards, etc. and light industries engaged in such activities as the design, assembly, finishing, processing, and packaging of products.

(h) **Mixed Urban** (Code U) - Urban area where no single use category predominates. These will generally be a mixture of residential and commercial uses, although any combination is possible.

(i) **Medical Facilities/Medical Complexes** (Code M) - An area of a large hospital complex or medical research institution with its associated structures and facilities used for the care and treatment of patients or biological research.

(j) **Unknown** (Code X) - Urban area for which neither a predominant use nor a mixture of uses can be determined from the source material.

(3) Settlement Pattern (Based on street pattern) - The urban area settlement pattern is defined as the modal or most frequently occurring geometric configuration (pattern) of streets found in a specified urban space or classified polygonal unit. Patterns of urban streets are to be classified and coded into twelve categories:

(a) **Regular, Rectangular** (Code RR) - Streets form an intersecting grid pattern of approximately regularly spaced lines at right angles to each other.

(b) **Irregular, Rectangular** (Code IR) - Same as above, except all the streets are not continuous. This causes blocky irregularities in the pattern. This is often done to form small urban parks, or to discourage through traffic in a residential neighborhood.

(c) **Regular, Radial** (Code RD) - The streets tend to radiate out from a central point in a somewhat evenly spaced pattern in all directions like the spokes on a wheel. Side streets connecting to the radials tend to be unevenly spaced and to connect only a couple of the radials instead of going completely around.

(d) **Irregular, Radial** (Code ID) - Same as above, except radial spokes are unevenly spaced.

(e) **Regular, Concentric** (Code RC) - The main street pattern is a series of some what evenly spaced, increasingly large circles around a central point. Side streets connecting to the circles tend to be unevenly spaced and to connect only a couple of the circles instead of radiating out continuously from the center.

(f) **Regular Canals** (Code RL) - The main thoroughfare areas are a series of regularly spaced canals, similar to the regular rectangular street pattern.

(g) **Irregular Canals** (Code IL) - Same as above, except canals are unevenly spaced and arranged in relation to each other.

(h) **Contour Conforming or Regular Contouring** (Code CC) - The majority of the somewhat evenly spaced streets follow the contour of the land staying near the same elevation most of the way. Usually found in urban areas on steep slopes where a few steep and sharply twisting side streets connect the paralleling contour streets.

(i) **Irregular, Contouring** (Code IC) - Same as above except the contour following streets are unevenly or widely spaced from each other.

(j) **Irregular, Medieval or Preindustrial** (Code IM) - These areas are usually found in the center of older urban areas where streets expanded in irregular patterns from the center (usually a church or fortress) as the town grew.

(k) **Curvilinear (cluster) or Irregular Modern** (Code CM) - An area where the streets follow a planned pattern of curves and irregularities designed to discourage through traffic and insure increased privacy. Usually only found in residential neighborhoods.

(l) **Linear (strip)** (code LS) - Urban area has one main street and perhaps a short paralleling side street or it stretches out in both directions along two main intersecting roads (in outline looks like a cross). This type of pattern is also sometimes referred to as strip development and is common on the edge of expanding urban areas or in rural areas where the main thoroughfare or intersecting roads are the only ones paved or otherwise improved.

(m) **Mixed** (Code MX) - The street pattern is a combination of two or more of the above patterns; none of which alone adequately describes the pattern.

(4) Predominant Urban Area Heights

(a) The predominant height of an urban area is defined as the modal or most frequently occurring height of the tallest buildings covering 10% or more of the land area in a specified urban area; i.e., the majority height of the tallest buildings covering at least 10% of the designated zone.

(b) Eleven predominant height classes (in meters) are coded:

Height Range	Map Unit Code
<= 10	01
> 10 - 20	02
> 20 - 30	03
> 30 - 40	04
> 40 - 50	05
> 50 - 60	06
> 60 - 70	07
> 70 - 80	08
> 80 - 90	09
> 90 - 100	10
> 100	11

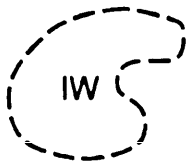
30.3 Miscellaneous feature specifications.

30.3.1 General features.

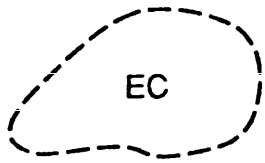
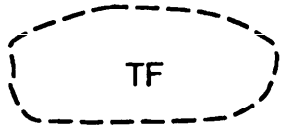
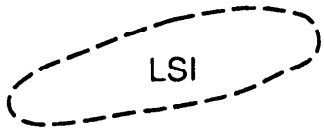
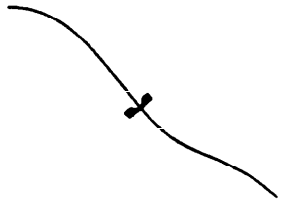
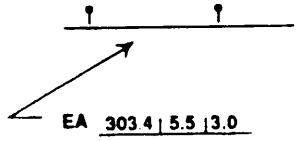
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Lines for Underlining:			
Dash/Dot	-----------	Lineweight: 0.30mm (.012in) Dot diameter: 0.30mm (.012in) Dash length: 1.0mm (.04in) Space: 0.5mm (.02in)	107

30.3.2 Miscellaneous vegetation and surface materials features. Miscellaneous features on these two areal thematic overlays use the same symbol (Symbol 103) as their regular polygons with only the alphanumeric codes changed.

30.3.3 Surface drainage features.

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Intermittent Lake		Letters "IW" in Univers Caps within dashed line Lineweight: 0.50mm (.02in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in)	501
Wash/Wadi		Letters "WS" in Univers Caps within dashed line. Lineweight: 0.50mm (.02in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in) Islands: Lineweight: 0.30mm (.012in) Dash length: 1.0mm (.04in) Space: 0.50mm (.02in)	507

30.3.3 Surface drainage features (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Area of Enmeshing Channels		Letters "EC" in Univers Caps within dashed line Lineweight: 0.5mm (.02in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in)	508
Tidal Flats		Letters "TF" in Univers Caps within dashed line Lineweight: 0.50mm (.02in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in)	509
Land Subject to Inundation		Letters "LSI" in Univers Caps within dashed line Lineweight: 0.50mm (.02in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in)	510
Weir		Notched block across stream Plot to scale or minimum size: 1.0mm width X 4.0mm long (.04in X .16in) Notch opening: 45° on each side from center of bottom or one side, faces upstream	515
Elevated Aqueduct (bridge-like)		Letters "EA" in 7 pt. Univers Bold Condensed Caps over solid line (bounded by Point of Change Markers, as necessary) Lineweight: 0.30mm (.012in)	518
Elevated Aqueduct Information Holder		Baseline with ticks and numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length: baseline: 18.0mm (.71in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in) Leader lineweight: 0.20mm (.008in)	519

ops. These include factors which interfere with visibility, ... and/or foot tra...

30.3.3 Surface drainage features (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Representative Pattern Area	Numerous Small Ditches 113223311 - 112334411 25 - 30 meter spacing	Letters and numbers in Univers C/L within dashed line Lineweight: 0.50mm (.012in) Dash length: 3.0mm (.12in) Space: 1.0mm (.04in)	520
Feature Under Construction	UC	Circle with letters "UC" in 7 pt. Univers Bold Cond. Caps inside Lineweight: 0.30mm (.012in) Circle dia.: 6.0mm (.24in) Posicut No. 1414	521

30.3.4 Transportation features.

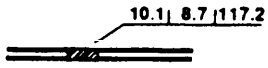
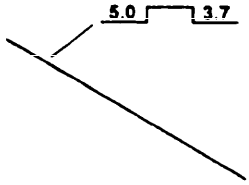
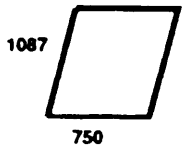
FEATURE	SYMBOL	SPECIFICATIONS	NO.
Trail	.....	Dot diameter: 0.75mm (.030in) Dot space: 2.0mm (.08in)	605
Restricted Passage (Width in meters)	a. 7.3 5.2 b. 2x7.5 5.2	Two open equilateral triangles perpendicular to road with numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length of each side: 2.5mm (.10in) Spacing = lineweight of road plus 0.25mm on each side. a. Restriction <2mm (100m ground distance) in length b. Restriction 2-10mm (100m-500m g.d.) in length	608
Abandoned Railroad	abandoned	Word "abandoned" in 7 pt Univers Bold Cond. LC above any railroad symbol.	619
Canal		Lineweight 0.50mm (.02in) Tick Space 2.0mm (.08in) Tick length 0.5mm (.02in)	624

factors for the a. Tree spacing, stem diameter, and vegetation roughness

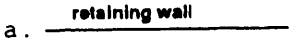
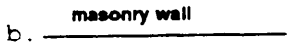
30.3.4 Transportation features (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Elevated Road/ Railroad/Canal	a. ER b. ERR c. EC	Letters "ER", "ERR", or "EC" in 7pt. Univers Bold Cond. Caps respectively above any road, railroad, or canal symbol a. = Elevated Road b. = Elevated Railroad c. = Elevated Canal	625
Elevated Road Information Holder	ER 10.24|156|E	Baseline with ticks and letters and numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length: baseline: 18.0mm (.71in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in)	639
Canal Bridge Information Holder	a. U 25.0 319 85.5 b. U 15.7 320 495.7	Open triangle with letters and numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length each side: 7.0mm (.28in) Leader Lineweight: 0.20mm (.008in) a. Bridge length < 2mm (<100m ground distance) b. Bridge length >= 2mm (>= 100m ground distance)	629
Culverts	a. c b. c c. c	Letter "c" in 7 pt. Univers Bold Cond. LC Leader Lineweight: 0.20mm (.008in) a. Road culvert b. Railroad culvert c. Canal culvert	630

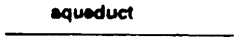
30.3.4 Transportation features (Continued).

FEATURE	SYMBOL	SPECIFICATIONS	NO.
Snowshed/Gallery	a.  b.  c.  d.	Rectangle with parallel hash lines Plot to scale or minimum size Lineweight: 0.30mm (.012in) Minimum width: 1.5mm (.06in) minimum length: 1.0mm (.08in) Diagonal lines: angle: 45° spacing: 0.5mm (.02in) Associated transportation symbol is suppressed inside snowshed/gallery a. Dual lane divided highway b. Single lane highway c. Railroad d. Canal	633
Snowshed/Gallery Information Holder		Baseline with ticks and numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Length: baseline: 24.0mm (.96in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in) Leader lineweight: 0.20mm (.008in)	634
Overhead Obstruction Information Holder		Jointed baseline with numbers in 7 pt. Univers Bold Cond. Lineweight: 0.30mm (.012in) Horizontal lines length (each of 3):6.0mm (.24in) Vertical lines length (each of 2):2.5mm (.10in) Leader linewt: 0.20mm (.008in)	637
Landing Area	a.  b. 	Heavy outline around area with numbers in 7 pt. Univers Bold Cond. Caps Lineweight: 1.0mm (.04in) Orient and plot to scale Minimum outside diameter: 4.0mm (.16in) a. Parallelogram, at scale b. Circular, minimum size	640

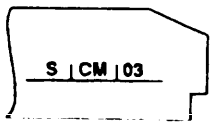
30.3.5 Obstacle features.

FEATURE	SYMBOL	SPECIFICATION	NO.
Wire/Wood Fence		Cross ticks on line Lineweight: 0.30mm (.012in) Tick length: 2.0mm (.08in) Cross tick space: 7.0mm (.28in) Ticks meet at center of line, perpendicular to each other and at 45° angle to line. Must have at least one set of cross ticks per line. DMA Posicut No. 1414	702
Wall	a.  b. 	Words "(type) wall" in 7 pt. Univers Bold Cond. LC above line Label type of wall if known. Lineweight: 0.30mm (.012in)	703
Shelterbelt/ Windbreak		Touching circles Circle Dia.: 2.0mm (.08in) Lineweight: 0.30mm (.012in)	705
Kanat		Circles on dashed line Lineweight: 0.30mm (.012in) Full dash length: 1.0mm (.04in) Half dash length: 0.5mm (.02in) Space: 0.5mm (.02in) Circle Dia.: 2.0mm (.08in)	710
Anti-Tank Ditch		Words "tank trap" in 7 pt. Univers Bold Cond. LC above line Lineweight: 0.30mm (.012in)	713
Impact Area		Words " impact area" in 7 pt Univers Bold Cond. LC within solid outline (Symbol 103) Lineweight: 0.30mm (.012in)	714

30.3.5 Obstacle features (Continued).

FEATURE	SYMBOL	SPECIFICATION	NO.
Minefields		Word "minefield" in 7 pt. Univers Bold Cond. LC within solid outline (Symbol 103) Lineweight: 0.30mm (.012in)	715
Aqueduct		Word "aqueduct" in 7 pt. Univers Bold Cond. LC above line Lineweight: 0.30mm (.012in)	718
Elevated Structure		Letters "ES" in 7 pt. Univers Bold Cond. Caps above line Lineweight: 0.30mm (.012in)	719
Wooded Gully		Rectangles with centered circles Lineweight: 0.30mm (.012in) Long line spacing: 2.0mm (.08in) Short line spacing: 3.0mm (.12in) Circle Dia.: 2.0mm (.08in)	721

30.3.6 Urban area features. Urban areas are shown on a combined Obstacles-Urban Areas Overlay with the use of the general areal feature symbol (Symbol 103) and an Urban Areas information holder symbol (Symbol 722), which contains the alphanumeric codes for predominant land use, settlement pattern, and predominant urban area height.

FEATURE	SYMBOL	SPECIFICATION	NO.
Urban Area Information Holder		Baseline with ticks and letters and numbers in 7 pt. Univers Bold Cond. within urban area outline (Symbol 103) Lineweight: 0.30mm (.012in) Length: baseline: 18.0mm (.71in) ticks: 2.0mm (.08in) Tick spacing: 6.0mm (.24in)	722

30.4 Miscellaneous feature and attribute changes to legends. If any of the miscellaneous features or attributes listed in this appendix are used on a TTADB, the various thematic legends shall be modified to accommodate the feature(s) and/or attribute(s).

30.4.1 Surface configuration legend modified:

MAP UNIT CODE	SLOPE (%)
A	0 - 3
B	3 - 10
C	10 - 15
D	15 - 20
E	20 - 30
F	30 - 45
G	45 - 60
H	>60
Y	Naturally and/or culturally dissected land (0 - >60)
W	Open Water

30.4.2 Vegetation legend modifications.

a. Vegetation legend additions:

A5	Agriculture (with scattered woodlots)
A6	Agriculture (with scattered trees/rows of trees)
A7	Agriculture (ditch irrigation)
IN*	Swamp (Nipa)
TA	Tundra (Alpine)
TB	Tundra (Brush/Shrub)
TH	Tundra (Herbaceous)

b. Change undergrowth attribute section to the following:

UNDERGROWTH

———————— Dense undergrowth
---------- Sparse-medium undergrowth
..... No undergrowth

(No underline indicates presence and/or density of undergrowth is unknown)

30.4.3 Surface materials legend modifications:

a. Surface materials legend additions:

CM	Inorganic clay and silt combinations (CL-ML).
RF	Rock Field

b. Soil moisture attribute addition:

..... Soil normally frozen

30.4.4 Surface drainage legend modifications:

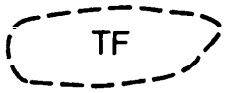
a. Surface drainage legend additions:

EA A | B | C Elevated Adequate (bridge-like)
A. - Length
B. - Waterway width
C. - Waterway Depth

Intermittent Lake

Wash/Wadi

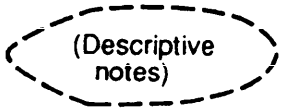
Area of Enmeshing Channels (Subject to Sheet Flooding)



Tidal Flat


Weir

Feature Under Construction

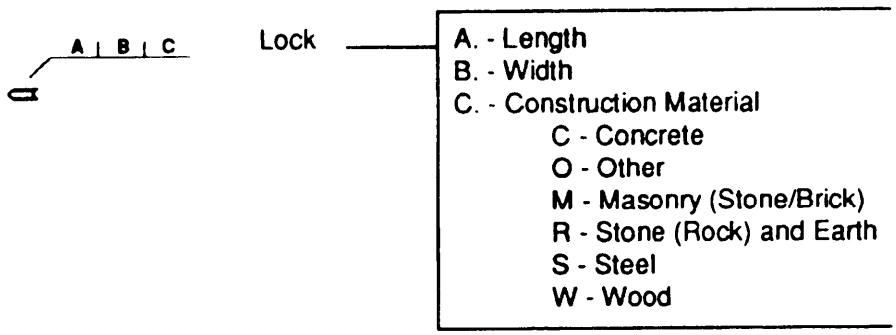


Representative Pattern Area

b. Additional dam construction material categories:

Dam Information Holder Code	Construction Material
R	Stone (Rock) and Earth
W	Wood
O	Other

c. Change lock section of legend to:



d. Additions to 1st digit (Drainage type) of the Surface Drainage Coding Table:

Anastomosing Stream	7
Wash/Wadi/Arroyo	8

e. Change codes of 2nd digit (Military gap width) of the Surface Drainage Coding Table to the following, in order to reflect more precise range of gap widths:

No Data	0
<= 4.5	1
> 4.5 - 18	2
> 18 - 30	3
> 30 - 50	4
> 50 - 75	5
> 75 - 100	6
> 100 - 142	7
> 142	8

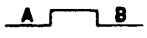
f. Addition to 3rd digit (Bottom materials) of the Surface Drainage Coding Table:

Peat and/or highly organic material	8

30.4.5 Transportation legend modifications:

a. Transportation legend additions:

(1) General Transportation Features section:



Overhead Obstruction Information Holder
A. = Horizontal Clearance (meters)
B. = Overhead Clearance (meters)

(2) Roads section:

Trail (average width is 2.5-3.0 meters*)

Restricted Passage (narrower than rest of road)
A. = Width (meters)

ER A | B | C — Elevated Road
A. = Width (meters)
B. = Military Load Classification
C. = Bridge Bypass Conditions
(See road bridges)

c — Culvert

*Example only tailor for each project area

(3) Railroads section:

ERR — Elevated Railroad

(4) New canals section:

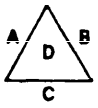
SYMBOL	CANALS (NAVIGABLE)	12pt. Caps
----------	Canal (Inland Waterway)	10pt. C/l
EC	Elevated canal (waterway)	

(5) Bridge data section:

(a) Railroad Bridge Information Holder:

C. - Bridge Number
(see Bridge Information Table)

(b) New canal bridge information holder segment:



Canal Bridge Information Holder
A. - Overhead Clearance (meters)
U = Unlimited
R = Restricted
B. - Overall Bridge Length (meters)
C. - Waterway Width (meters)
D. - Bridge Number
(see Bridge Information Table)

Attach Figure 13, Bridge Side View Nomenclature. This span length is the one

(6) New snowshed section:

SYMBOL SNOWSHED, ROCKSHED, AND GALLERY DATA 12pt. Caps

Snowshed, Rockshed, or Gallery

10pt. C/l

A | B | C Snowshed/Rockshed/Gallery Information Holder
A. - Overhead clearance (meters)
B. - Width (meters)
C. - Length (meters)

b. Transportation attribute changes

(1) Add bridge numbers for railroad and/or canal bridges to the BIT.

(2) Add horizontal clearance (HZC), bridge architectural type (BAT), and bridge movement type (BMT) columns to the BIT.

(3) Add HZC, BAT, and BMT acronyms to BIT marginal data (see 3.11.6.8, notes).

BAT = Bridge Architectural Type
BMT = Bridge Movement Type
HZC = Horizontal Clearance

(4) Add BAT and BMT codes to BIT marginal data (see 3.11.6.8, Codes).

BAT Codes: A = Arch, Closed Spandrel, O = Arch, Open Spandrel, B = beam, C = cable staged, V = cantilever, F = floating, G = girder, S = slab, P = suspension, T = truss, X = other.

BMT Codes: B = bascule (drawbridge), F = fixed, C = lift (vertical), R = retractile, S = swing, X = other.

c. Columns for the HZC, Overall Structure Length, BAT, and BMT attributes should be added to the BIT as shown in the modified columnar headers style sheet (see Appendix A, BIT style sheet, section D.) in Figure 88.

30.4.6 Obstacle legend modifications:

a. Obstacle legend additions:

Shelterbelt/Windbreak

aqueduct

On-Ground Aqueduct (wall like)

ES

Elevated Structure (Low enough to prevent the MBT from passing under)

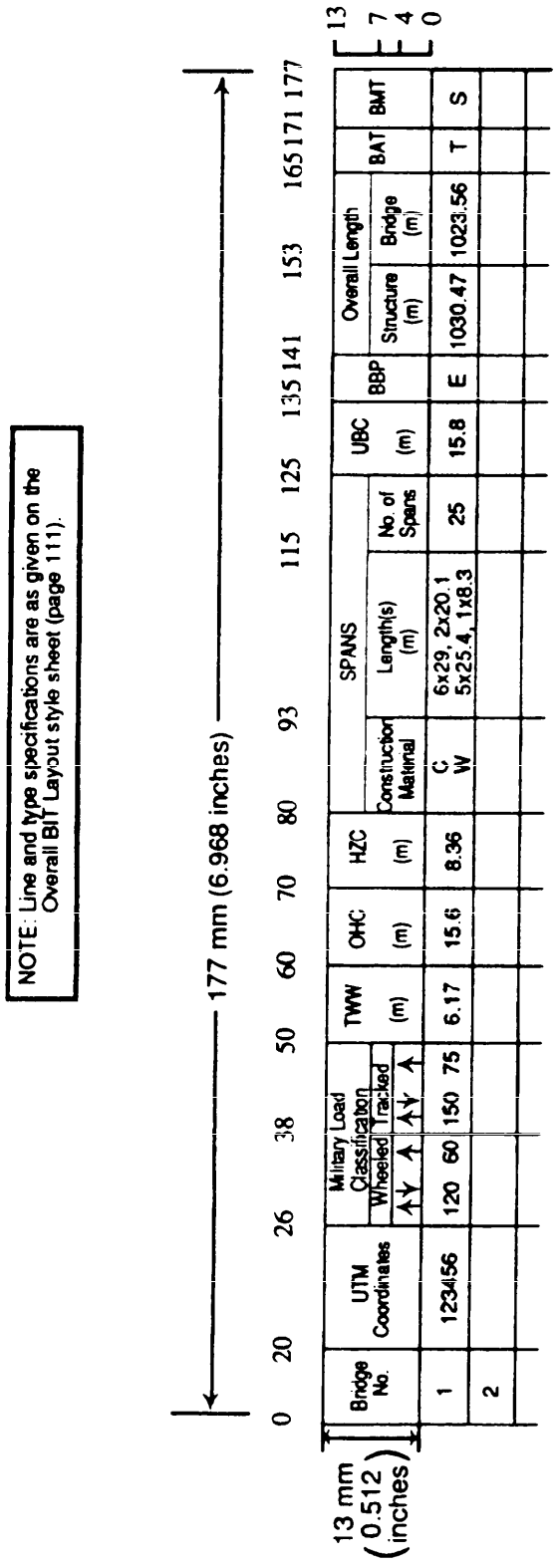
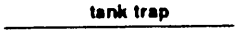


FIGURE 88. Modification of BIT columnar headings for miscellaneous bridge attributes.

Wooded Gully



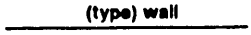
Anti-Tank Ditch

Impact Area

Minefield

Urban Areas
A = Predominant Land Use
B = Settlement Pattern
C = Predominant Urban Area Height

Fence



Wall, types:
(a) Retaining
(b) Masonry
(c) Steel
(d) Wood
(e) Other - label as to type
(f) Unknown

b. Urban areas attribute addition(s) to the Obstacles Overlay:

PREDOMINANT LAND USE TABLE — 12pt. Caps

MAP UNIT CODE	LAND USE CATEGORY	12pt. Caps
R	Residential	
S	Recreational	
G	Institutional	
A	Military	
T	Transportation and Utilities	10pt. C/l
C	Commercial	
I	Industrial	
U	Mixed Urban	
M	Medical Complex	
X	Unknown	

SETTLEMENT PATTERN TABLE — 12pt. Caps

MAP UNIT CODE	URBAN STREET PATTERN	12pt. Caps
RR	Regular, Rectangular	
IR	Irregular, Rectangular	
RD	Regular, Radial	
ID	Irregular, Radial	
RC	Regular, Concentric	
RL	Regular, Canals	
IL	Irregular, Canals	10pt. C/l
CC	Contour Conforming (Regular Contouring)	
IC	Irregular, Contouring	
IM	Irregular, Medieval or Preindustrial	
CM	Curvilinear (Cluster) or Irregular Modern	
MX	Mixed	

URBAN HEIGHT TABLE — 12pt. Caps

MAP UNIT CODE	HEIGHT RANGE (meters)	12pt. Caps
01	<=10	
02	>10 - 20	
03	>20 - 30	
04	>30 - 40	
05	>40 - 50	
06	>50 - 60	10pt.C/l
07	>60 - 70	
08	>70 - 80	
09	>80 - 90	
10	>90 - 100	
11	>100	

c. If the urban areas section of this appendix is in effect, the overlay heading (name) of this thematic overlay, as given in 3.11.5.3, shall be changed to Obstacles-Urban Areas. In addition, the DMA stock number identification code for this specific terrain factor overlay, as given in 3.11.5.4.4d, shall be the next available free "T" number within the obstacles identification codes group, such as T11.

30.4.7 Need for legend modifications. Legends shall be modified to show only those miscellaneous features and attributes actually appearing on any of the various TTADB overlay sets of a project area, **as prescribed by supplemental project instructions**.

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and perennial stream segment are [illegible] (c) [illegible] wash(wag) boundary

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CONCLUDING MATERIAL

Custodians:
DMA - MP

Preparing activity:
DMA - MP

(project MCGT-0028)

Review activities:
Army - PO
Air Force - 09
Navy - NO

User activities:

Air Force: HQ AFIA-INTB (09)

Army: USA-FSTC-CB1; CDRWESTCOM-APIN-MCG; CDR25THINFDIV; CDRUSAASDE; CDRUSAETL-CEETL-TC-SA

DMA: DMS-MTM; DMAHTC-SXM; DMACSC-LANT; DMAIAGS; DMAHTC LOU-LUA ; DMAAC-DAP; DMAHTC-VRM

NSA: NSA-GIC-T5141

Navy: USEUCOM-ECJ2-T; CINCPAC-J37; CINCUSNAVEUR-N39; CG MCCDC-IN11; CG FMFLANT-AC/S, G-2; CG FMFPAC-AC/S, G-2

TVA: TVA-NSD-HB 2N 200A

Canada: M&CE

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4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
DEFENSE MAPPING AGENCY	(703) 285-9199	356-9198
c. ADDRESS (Include Zip Code) ATTN: PRS 8613 Lee Highway, Fairfax, VA 22031-2137	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:	